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Editorial

TRAINING AFTER COLOSTOMY*

ONE of the principal reasons most patients dread colostomy is the fear that they will have to wear a colostomy bag for the rest of their days. Failure of surgeons to educate their patients in the control of a colostomy opening with the resultant reliance upon objectionable fecal-collecting devices is to be deplored.

Nearly all patients having a sigmoidal abdominal anus can be trained to have a single bowel movement daily at a scheduled time. Were the technic employed in this training more widely known and used, there would be less colostomy phobia.

In the last twenty-five cases which we personally handled, complete control of feces was obtained in twenty-three. Of the failures, one patient sustained a cerebrovascular accident on his third postoperative day and remained mentally incompetent until the time of his death. The other patient was incompletely instructed while in the hospital and returned wearing a colostomy bag of a type recommended by a friend. This patient never made a serious effort to learn control.

The technic which we have employed is chiefly psychologic and consists of a series of talks. A few days after colostomy the surgeon sits at the patient's bedside and speaks in terms which can be understood. The patient is told that he no longer has a sphincter muscle to control his stool and must substitute a series of reflexes. His training period is likened to that of a baby who is placed upon the toilet seat to train him to defecate. The burden for developing this defecation reflex is placed upon the patient. His first duty is to record the time when his abdominal anus is moving. Most patients evidence a rhythm even in the early postoperative days.

Several days later the second instruction period is held. One-half hour before the anticipated time of the patient's largest movement he is ordered to administer an enema. He is shown how he must insert the tip of an 8 ounce bulb-type syringe into the stoma of his colostomy opening and introduce two syringe bulbs full of warm tap water as his irrigation. The patient then holds a pad against the stoma and walks about the room for five minutes. Thereafter, fluid and stool are evacuated into a large kidney basin held beneath the colostomy. Once the time of the irrigation is set, it must be adhered to daily. The nurse in attendance must do no more than hand the syringe to the patient. Some individuals prefer to introduce the fluid sitting up; others are unable to retain it except in the prone position during the early training period. Only clear water may be returned for the first twenty irrigations although most patients have results within the first five. It is emphasized that there should be no stool except with the daily enema. For each evacuation other than that with the irrigation the giving of 4 cc. or more of paregoric is prescribed.

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A third talk places the future management in the patient's hands. As he gains confidence, he is ordered to reduce the size of his dressings until eventually only an eye patch is used to cover the colostomy orifice, the paucity of the patch being a factor in his psychologic training. Many failures must be anticipated before complete confidence is obtained. However, by the time the patient is ready for discharge from the hospital he will have some success with his control of the colostomy opening and be quite proud of it.

Upon discharge, together with bulb syringe and kidney basin the patient is given a prescription for paregoric and warned to observe what foods produce diarrhea. These can be checked by dietary experimentation and should be excluded from his diet. In our experience, corn, bananas, cabbage, prunes and beer have been the most frequent offenders.

The surgeon does well to have colostomized patients return for follow-up visits at the same time. Those having control of gas will teach the partially controlled. More important, the latter will be inspired to search harder for the food, drinks, tobacco or even medication that causes flatus in their individual case. Some patients, alert to the sensation of peristaltic rushes, learn to fold their arms across their abdomen so that the anterior aspect of their left forearm inconspicuously causes pressure over the eye-patch-covered abdominal anus. By such methods many cases are reduced to only an occasional innocuous slip.

A well instructed colostomy patient is not retiring and looks with disdain upon anyone wearing a colostomy bag or appliance. He takes pride in mingling with society secure in the knowledge that his secret of an abdominal anus can be known to none save his physician and intimate friends.

PAUL MECRAY, JR., M.D. AND
HERBERT BOWMAN, M.D.

Modern Operative Technics

No. 1

TECHNIC FOR REPAIR OF VESICOVAGINAL FISTULA FOLLOWING TOTAL HYSTERECTOMY

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THE purpose of this paper is to present a transperitoneal transvesical technic for the repair of vesicovaginal fistula following total hysterectomy. The decline in incidence of vesicovaginal fistulas because of improved obstetrics has been balanced by an increased occurrence after radical gynecologic surgery.

Panhysterectomy, which is advocated for the prophylaxis of carcinoma in the cervical stump, confronts the surgeon with the possible risk of a complicating vesicovaginal fistula. Such fistulas, in contrast to those following obstetric procedures, are usually unsuitable for repair through the vagina. Their location above the interureteric ridge and the absence of the cervix to use as a tractor make vaginal accessibility very difficult. The suprapubic approach is more suitable for repair of these fistulas and is usually more successful.

In evaluating the accepted methods of suprapubic repair the transperitoneal transvesical route has the following advantages: Better exposure is obtained because the bladder is opened wide in the midline and there are no folds to obscure vision. Operating through the peritoneal cavity allows much greater freedom of movement than through the anterior wall of the bladder. The bladder can be more easily dissected from the vagina from this perspective and the epithelized fistulous tract can be excised under direct vision. Finally, with the bladder open the ureters can be visualized and catheterized if necessary.

TECHNIC

Preparation. After a complete workup which has made the diagnosis of vesicovaginal fistula the patient receives the following preoperative preparation: Three days prior to operation a Foley catheter is inserted through the urethra and the patient is given 100 mg. of aureomycin four times a day. A cathartic is given on the eve of surgery followed with a soap suds enema in the morning. The abdominal and pubic regions are shaved and washed. After the anesthetic has been given the vagina is irrigated with tincture of zephiran and packed with gauze, the end of which is allowed to dangle over the patient's thigh. The patient is placed supine on the table tilted to about 45 degrees Trendelenburg position. The skin is prepared with Scott's solution and the patient is draped.

Operation. An 8-inch Pfannenstiel incision is made 1 fingerbreadth above the pubic symphysis and carried down to the fascia. The skin and subcutaneous tissues are dissected superiorly. The anterior rectus sheath is incised transversely and the muscles are separated and retracted in the midline. The peritoneum is divided longitudinally under the usual precautions and a Balfour self-retaining retractor is inserted. The intestinal contents are packed into the upper abdomen with laparotomy pads. (Fig. 1.)

The bladder is now identified and opened at the attachment of the peritoneum. The incision is carried downward through all coats of the bladder including the peritoneum. The cut edges of the bladder are grasped with Allis clamps and held aside. This allows visualization of the fistula and ureteral orifices within its cavity. Under such vision the incision is carried down to the fistula. (Fig. 2.) The bladder is now pulled toward the pubic symphysis and the surgeon, working from within the peri-

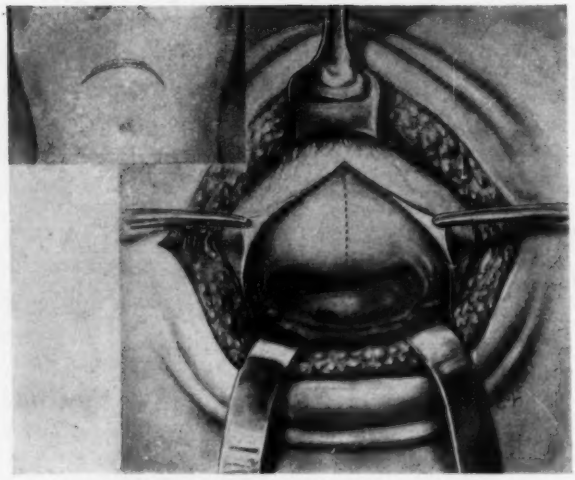

FIG. 1. Dotted line indicating line of incision of posterior bladder wall after intraperitoneal mobilization of bladder. Insert; Pfannenstiel incision of abdomen.

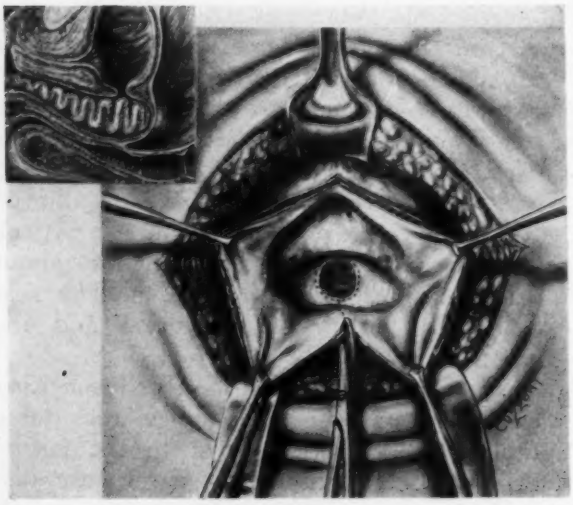

FIG. 2. Vagina packed with gauze to elevate floor of bladder. Bladder opened; incision being carried down to fistula. Insert; sagittal view.

toneal cavity, separates the bladder from the vagina at the site of the fistula by opening a Metzenbaum scissors in the septum between the organs. The lining of the fistulous tract is trimmed off and the edges of the vagina are grasped with Allis clamps. The bladder and vagina are further separated in order to obtain laxity of tissues for closure. At this point extreme caution should be taken not to injure the ureters and it is advisable that ureteral catheters be passed before any extensive dissection is done. (Fig. 3.)

An outside assistant then removes the vaginal pack. The edges of the vagina are approximated and everted with interrupted sutures of No. 0 chromic catgut used on a

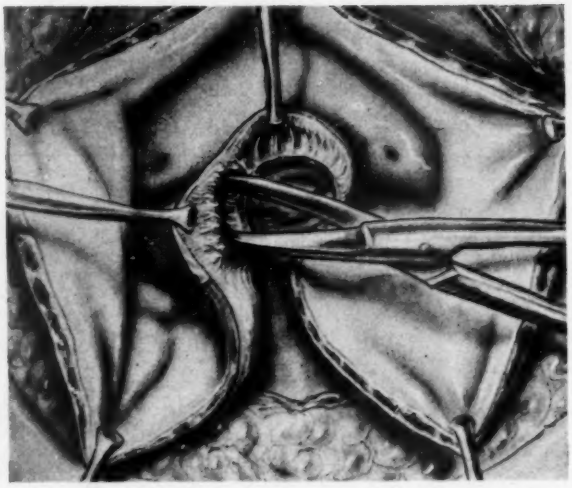

FIG. 3. Epithelialized fistulous tract being completely excised; bladder musculature dissected from vagina.

No. 6 Martin needle. If it is possible, this row of sutures is made at right angles to that closing the bladder.

As the bladder edges are drawn forward, the muscular layer is closed with interrupted sutures of No. 0 chromic catgut placed from the peritoneal cavity. This closure is made on the floor and midway up the peritoneal surface of the bladder. Then from within the bladder interrupted sutures of No. 00 atraumatic plain catgut are used to draw the urothelium together. From without, the closure of the bladder musculature is completed. The peritoneal coat of the bladder is next imbricated with a continuous suture of No. 00 chromic catgut. The laparotomy pads are removed and the peritoneum closed without drainage using a running suture. (Figs. 4, 5 and 6.)

The space of Retzius is opened; the extraperitoneal portion of the bladder is incised and a No. 36 Pezzar tube is inserted. The opening is closed tightly about the tube with interrupted No. 0 chromic catgut sutures. The wound is closed in layers. Plain catgut is used for muscle, chromic for fascia. Interrupted sutures of plain gut are used subcutaneously. The skin is approximated with interrupted vertical mattress sutures of black silk. A silk suture is put through the skin and the Pezzar tube which has been brought out through the center of the wound. A Malecot catheter is inserted through the urethra.

Postoperative Care. Upon returning to her bed the patient is given continuous bladder irrigation with sterile, normal saline through the urethral catheter and out the Pezzar tube. Vital signs are charted at frequent intervals for the first twenty-four hours. The patient is

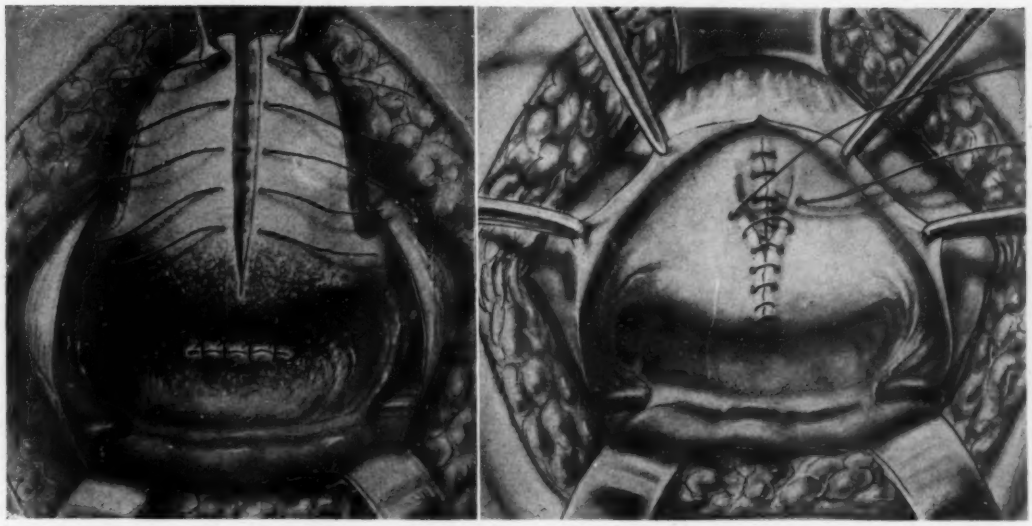

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FIG. 4. Vaginal opening closed with interrupted atraumatic chromic sutures in transverse direction; bladder muscles sutured in linear direction with interrupted atraumatic catgut.
FIG. 5. Imbrication suture line of peritoneal coat of bladder with continuous atraumatic catgut.

moved hourly in bed and lies supine. Crysticillin, 300,000 units, is given daily and dihydrostreptomycin in a dosage of 0.5 gm. is given every six hours. Demerol is used for postoperative pain. Nothing is given by mouth for the first twenty-four hours. Transfusion and infusions are given to maintain fluid and electrolyte balance.

Forty-eight hours postoperatively the irrigation is discontinued and both tubes are allowed to drain. On the fifth day after operation the patient dangles her legs and she is gradually mobilized on succeeding days. After one week the antibiotics are discontinued or decreased in dosage and the skin sutures are removed. Ten to fourteen days after surgery the Pezzar tube is removed. The urethral catheter, although it may be changed, remains *in situ* until the cystostomy wound has healed. The bladder is filled, the cystostomy wound and vagina are checked for leaks and the catheter is removed. The average hospital stay is about three weeks.

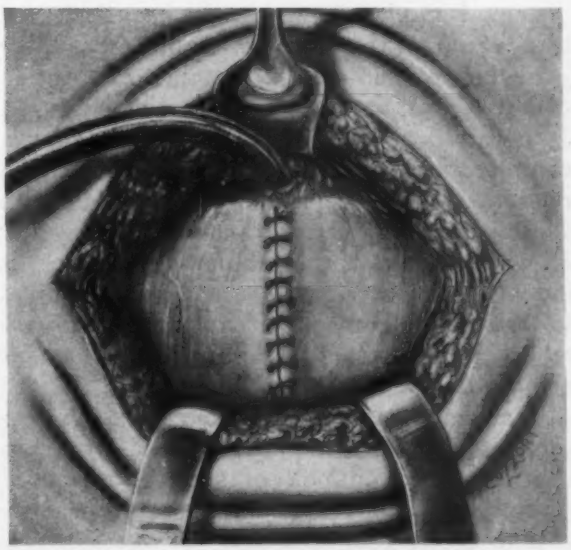

FIG. 6. Peritoneum closed; suprapubic drain inserted into extraperitoneal portion of bladder.

COMMENTS

The senior author has used this procedure in seven cases. Six have been successful with one attempt. A second procedure in the seventh case was successful in closing the vesicovaginal fistula; however, this patient developed an ureterovaginal fistula. In reviewing the results we found this procedure to be simple in operation and effective in results. Peritonitis has not been a complication, for which the modern antibiotics are given due credit. The danger of ureteral injury is no greater than that involved in any type of repair of a vesicovaginal fistula situated near the orifices. This can be greatly reduced with ureteral catheterization at the time of surgery.

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Original Articles

TECHNIC FOR THE EARLY OPERATION OF MYELOCELE AND MENINGOMYELOCELE

WITH A REPORT OF TEN CONSECUTIVE CASES

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EXAMINATION of the literature describing the surgical approach to spina bifida in infancy reveals many excellent articles both in the journals and in textbooks by Bucy, Ingraham, Vorhis and many others of equal merit. However, it has been the observation of the writer that nowhere is there available a complete and detailed description of the operation itself in any single source. It occurred to the writer, therefore, that a complete and detailed description of such an operation might be a welcome assistance to those who wish to undertake it. Nothing new is claimed for this technic; the writer is indebted to many authors and many sources for the ideas advanced herein, the only advantage being that they are all assembled under one heading.

Considerable skepticism among the profession has been encountered by the writer in regard to the outlook of surgical repair of myelocele and meningomyelocele. It has occurred to me that this may be due in some cases to the fact that a complete description of all the points of technic may not have been available to the surgeon at the time of operation. The problem of surgery appears to be a largely physiologic one involving principally the detection and separation of nervous elements from less important surrounding structures. The technic herein assembled has, therefore, been based on electrical stimulation of every thread that might prove to be a nerve, and arranged to render visible and palpable as many responses to stimulation as practical. If we are to credit the theory that the untoward consequences of spina bifida are due to prevention of the upward migration of the spinal cord in infancy with tension on the cauda equina below and Arnold-Chiari malformation above, release of all fixating elements is imperative.

OPERATION

If surgical attack upon the defect is made very early as was the case in the ten patients described herein, little time for preparation of patient is available. The baby, however, was placed face down over a blanket roll in a crib with the head of the crib elevated in such a way that the urine and feces would roll away from the defect. This has been described in many previous articles. Occasionally the parchment-like sac will bulge dangerously with the baby in the head-up position and it will be necessary then to place the crib in a horizontal position. A heating pad is introduced beneath the infant, a gooseneck light is directed downward upon the child from above to provide warmth, and all clothing except the diaper is removed to prevent any possible excoriation of the thin sac by rough garments. The diaper is applied to the baby's buttocks in the form of a sling; and since the legs are bent at thigh and knee over the blanket roll, it both catches the excreta and holds the baby in position.

Sometimes sterile cotton soaked in aqueous merthiolate is placed over the external surface of the sac and surrounding skin for a few hours preoperatively. Penicillin is usually given before operation in injections of 10,000 to 30,000 units every three hours.

Blood is prepared and a cut-down performed to allow for blood transfusion during surgery.

FIG. 1. Operative position.

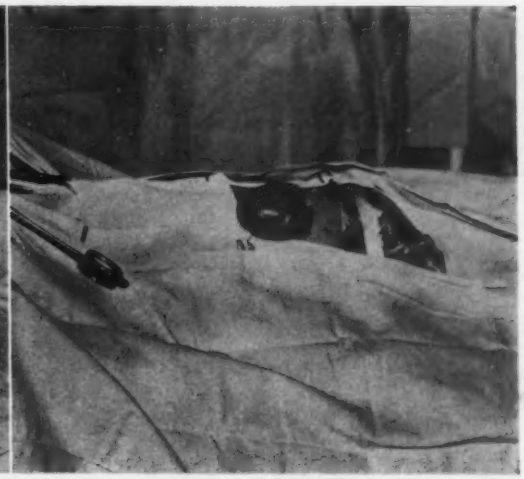

FIG. 2. Draping.

A retention catheter is placed in the bladder, later to be connected to a water manometer, for the purpose of viewing directly any contraction of the bladder due to stimulation of a motor nerve thereto.

Tiny blanket rolls are made of small towels placed horizontally on the table at the head end, parallel to each other and separated just enough to allow for abdominal breathing. On these the baby is placed face down with the thighs bent at a right angle. It is then tied in position with a muslin bandage about wrists and ankles and a narrow adhesive strip is drawn tightly over the sacrum sufficiently below the defect to allow a sterile field and affixed to the operating table. The aforementioned catheter is then connected to a water manometer at the anesthetist's station. This is soon filled with urine to a point easily seen by the anesthetist. A heating pad, covered with a water-resistant wrapper, is placed beneath the baby to minimize heat loss. This together with the warmth of the operating lights above and the drapes appears sufficient to maintain the body temperature.

Sometimes a small amount of ether is used but infants seem to do just as well with no anesthesia other than a "sugar tit" to quiet them.

After the area has been washed and painted with some aqueous sterilizing solution, sterile towels are placed about the prospective operative site except instead of a towel at the caudad end of the field a rectangle of plastic film, sterilized by soaking in aqueous solution of merthiolate, is substituted. By this device the rectal sphincter is kept under direct view at all times. One small thyroid sheet is then used to cover the infant. It is possible then by these devices to detect contractions of the bladder and of the rectal sphincter by direct vision and any muscular contractions of the lower extremities and back muscles by observation or by palpation. (Figs. 1 and 2.)

A cortical or nerve stimulator adaptable to delicate stimulation is used, such as that constructed by Dr. Stein and associates of the Illinois Neuropsychiatric Institute. Coagulation of bleeders is accomplished by a bipolar bayonet electrode such as that manufactured by Leibel Flarsheim Company of Cincinnati, O., and so constructed that the current passes only between the two points of the bayonet forceps and not through the infant's body. Otherwise, it is necessary to have only very small instruments easily available in most operating pavilions or from neighborhood sources. Tiny lens forceps, dural forceps, mosquito clamps, fine eye needles with appropriate silk, cuticle scissors and other small items are advisable.

In this series a vertical incision is made beginning at least two vertebrae above the defect as demonstrated by x-ray. A laminectomy of these two vertebrae is done on the theory that it is usual for the cord to rise only two segments, from L3 to L1, during the natural growth of the child. The laminectomy opens two segments above the defect to allow just that amount of upward migration to any bulbous malformation of the neural elements below this point. At the upper end of the defect just beneath the lowest lamina removed, a tough, fibrous, annular band is often found

constricting and fixing the widening sac below. (Fig. 3.) Whenever this band is found and cut, the dura above the defect and under the laminectomy appears immediately to become less tense. One child upon whom this laminectomy was not performed developed a tense

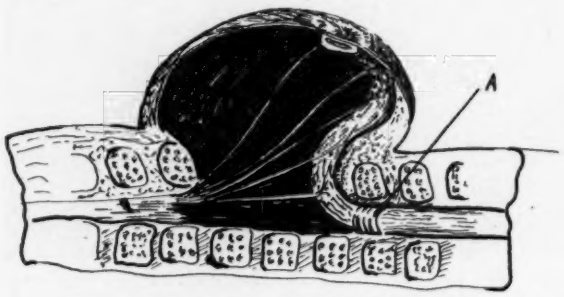

FIG. 3. Diagram of constricting band (A).

fontanel and a rapidly enlarging head within ten days. He was returned to the operating room, the laminectomy performed and such an annular band found and cut. After this the evidences of hydrocephalus subsided and he developed normally.

The laminectomy assists also in that the sac is then approached from normal dura. The sac is not preserved, except just enough when present, to form a complete dural canal. Where the cord and nerves of the cauda equina interfere with the removal of the sac by fanning out widely over the surface, they are peeled off the sac by sharp dissection and dropped back into the canal in as normal a position as possible. By this maneuver it is believed that the bulbous mass, incapable of migrating upward into a small canal above, is diminished in size. Also, when a large, tough, unyielding filum terminale is found, it is severed with the belief that it might resist upward migration. Next, whenever the dural canal is deficient or insufficient sac can be preserved to reconstitute it, a large piece of fascia lata is taken from one or both thighs to complete the covering of the neural elements. An attempt is always made to create three layers, namely, dura, fascia and skin. In this series most of the defects were so large that relaxing incisions in the abdominal wall to either side of the wound, extensive undermining and Z-plastic incisions were necessary to bring the skin edges together. Even then many of the wounds broke down from tension and had to be allowed to epithelize in. Some became infected and required prolonged treatment with antibiotics. The infection sometimes but not always appeared to interfere with the final result. Interrupted sutures of black silk were used throughout.

As a rule a small amount of penicillin solution, 10,000 units in 1 cc., is injected just beneath the skin before the dressing is applied. A sterile vaseline gauze is placed first over the wound, followed with sterile gauze and then a transparent, impervious material such as sterile sheet plastic. This is carefully sealed from the rectum with adequate adhesive tape.

The infant is again placed in a crib with the head end elevated as before. No postoperative oxygen or special supportive therapy is ordinarily found necessary. Most infants withstand operation surprisingly well and are able to nurse within a few hours. Postoperative penicillin and any other antibiotics deemed necessary are given as a rule. Special care must be taken by nurses handling these infants to prevent infection. The same discipline required for the care of premature infants should be instituted. For some reason not understood at present the majority of the infants in this series developed postoperative diarrhea which, in one or two cases, proved hard to treat. It usually cleared up in the matter of a week or so.

CASE REPORTS

Ten consecutive, unselected patients with spina bifida were treated using this method. To say that they were unselected may convey a false impression. Rather, they were accepted as they came without eliminating or refusing any. Fortune presented only thoracolumbar, lumbar and lumbosacral cases. The highest extended to D10; the lowest was well down into the sacrum. In all but one cauda equina elements formed a part of the sac constituting by definition a myelomeningocele. The sacs ranged from 2 to 10 cm. in diameter. Eight were of the large variety with sessile base, parchment-like covering or no covering at all. Five were leaking at the first examination. In one the obstetrician, thinking he had a breach, had thrust his finger through the large sac into the dural canal. Two had definite evidence of hydrocephalus preoperatively and one moved neither foot nor leg before surgery.

The majority of these cases presented a discouraging outlook and the question arises as to

whether any such deserved surgery at all. However, Ingraham and Lowry have estimated that 25 per cent of normal children have occult bony spina bifida without neurogenic complications. Since the incidence in the adult population is far less than this, it must be assumed that some of these defects correct themselves in the natural process of growth. It is only a step, then, to hypothesize that soft tissue, given proper direction by surgery, may proceed in some instances in its morphogenetic development.

Sachs and others recommend operation in early infancy. Ingraham and Vorhis, on the other hand, advise waiting from one to eighteen months before surgery is undertaken. Campbell in conjunction with Ingraham, while advocating the long waiting period says that during this trial of waiting and decision most patients with meningomyelocele die with intercurrent respiratory infection, meningitis, ascending urinary sepsis or other maladies. Even with this policy of survival of the fittest Campbell reported only 30 per cent normal or near normal as a final result. It is this very group, in which most patients would die during a prolonged waiting period, that was accepted in this series.

Case 1. Baby A had a wide based meningomyelocele, lumbar and sacral, 10 cm. in diameter, with a completely parchment-like sac through which the cord and nerve elements could plainly be seen arching up into the dome and closely adhering to the surface. The upper end of the sac was leaking. (Fig. 4.) The child was a full term 7 pound, 15 ounce female moving all extremities. The sphincters were intact but the child had a bulging, tense fontanel and so-called hydrocephalic facies. The head was considered by the pediatrician to be definitely larger than normal.

The child was operated upon the second day after birth. The operating time was two hours and forty-five minutes. At operation the lower end of the spinal cord and some nerves of the cauda equina were found so tightly attached to the sac as to necessitate peeling them off by sharp dissection. The neural elements otherwise were well formed. A hypertrophied filum terminale was cut.

The base of the soft tissue defect was so wide that fascia lata from the thigh was required to fashion the fascial layer of the closure and the skin had to be widely undermined, cut and slid into place; relaxing incisions in the abdominal wall were necessary. (Figs. 5 and 6.)

Fig. 4. Baby A.

When last seen the child was a year and five months old. The report of the pediatrician stated that the hydrocephalus was adjudged arrested as of the operative date. Limbs and sphincters worked normally and the mental development was at least average. She was beginning to talk and walk and was a bright, alert child. The back appeared well healed. The only aberration from normal physiology appeared to be rather persistent constipation.

Case 11. Baby Lig. had a moderate-sized myelomeningocele with a sessile base and a parchment-like dome, lumbar sacral in position. It was about the size of a silver dollar. The child was an eight and a half month, 5 pound, 6 ounce male with good use of all extremities, intact sphincters and no evidence of hydrocephalus.

He was operated upon the sixteenth day after birth. The operating time was three hours. At operation it proved to be a very difficult repair. The cord was found to be knuckled up into the sac for about one-third of the diameter of the sac. It was necessary to use sharp dissection to separate both cord and cauda from the sac wall. Tight bands of adhesion everywhere hampered the release of the fixed neural elements. A fascial transplant and

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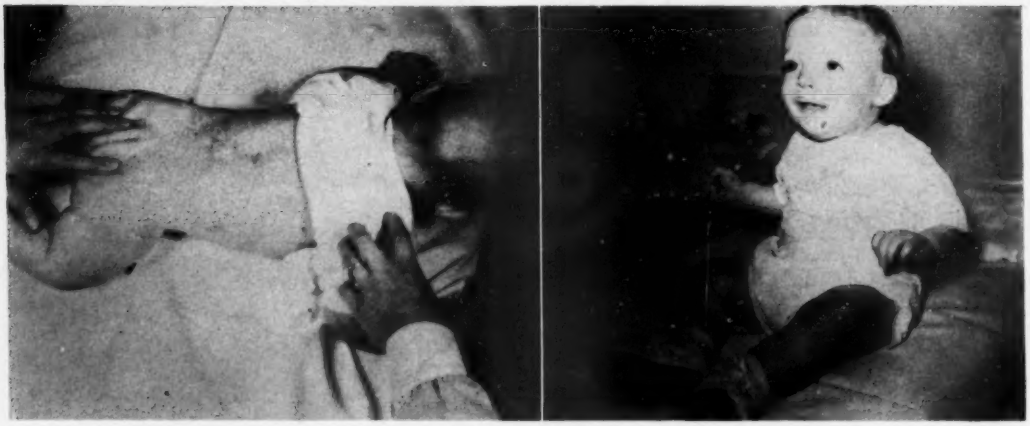
FIGS. 5 and 6. Baby A.



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FIGS. 7 and 8. Baby Lig.

wide undermining of the skin were necessary for closure.

One year and four months after operation the mental and physical development of the patient was declared better than normal by the pediatrician. There was no sphincter, bladder or bowel disturbance. (Figs. 7 and 8.)

CASE III. Baby Le. had a very large meningomyelocele 8 cm. in diameter, lumbosacral, with a wide, sessile base, covered almost completely with skin except for a gaping hole at the very center. The sac had presented at the time of birth and the obstetrician, thinking he had a breach, had thrust his finger directly through it. (Fig. 9.) The infant was a full term 6 pound, 5 ounce male with sphincters intact who was able to move all four extremities. There was no evidence of hydrocephalus.

The child was operated upon twenty-four hours after birth; operating time was three hours. At operation the adhesions were numerous and dense and the cord and dura were developed with considerable difficulty. One large nerve root made a loop over the inner surface of the sac and was so much a part of the sac wall it had literally to be cut out of the sac wall by sharp dissection. However, following this it appeared to be functioning when stimulated as evidenced by a sharp rise of fluid in the manometer connected to the bladder. All excess sac was removed and there was sufficient dura, fascia and skin to close without resorting to unusual measures.

Eleven months postoperatively the pediatrician reported that the development was normal, the child sitting up at six months and otherwise following an average pattern. There was no hydrocephalus; the sphincters were intact. Movement and strength of extremities were within normal limits.

CASE IV. Baby T had a saucer-sized lumbar meningomyelocele with a wide, sessile base, easily the largest defect of the series. The dome was entirely parchment-like and through it

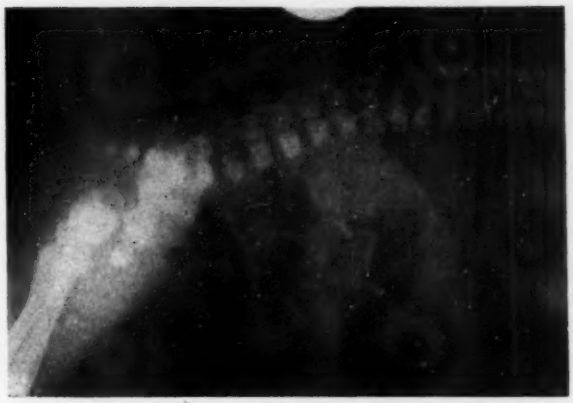


FIG. 9. Baby Le.

FIG. 10. Baby T.

cord and spinal nerves appeared, diffusely distributed over its surface and tightly adherent. (Fig. 10.) The child was a 7 pound, 10½ ounce full term male delivered with low forceps. His sphincters were intact and he could move both legs. There was no hydrocephalus.

The child was operated upon the fifth day after birth; operating time was three hours. Repair was extremely tedious, the cord and many nerves requiring removal from the sac by sharp dissection. Moreover, considerable time and every trick was necessary to bring about a closure of the wide opening. Because of this the usual laminectomy above the wound was not done.

On the tenth postoperative day a tendency toward hydrocephalus was plainly evident to the pediatrician and surgeon alike. Moreover, the wound had spread and showed a low grade infection. In spite of this the laminectomy was done and a tight, annular band of adhesion above the defect was discovered and cut. Although the infection continued for some time and the wound continued to spread and required pinch grafts later, the hydrocephalic tendency immediately regressed and the fontanel became soft.

Eleven months after operation the pediatrician reported a normally developed infant with intact sphincters and no evidence of hydrocephalus. (Figs. 11 and 12.)

CASE V. Baby S had a small defect, a myelocele, in which a large, meaty filum terminale was found attached to the very center of the sac. The child was a 6 pound, 15 ounce full term male, with full control of the sphincters and lower extremities.

He was operated one week after birth; operating time was one hour. The closure was not difficult. Eight months later the family doctor reported the child normal in every respect.

CASE VI. Baby G had a very large meningomyelocele with a wide, sessile base 7½ cm. in diameter and lumbar in position with parchment-like dome. The child was a 7 pound, 4½ ounce full term male with a deformity of the arch of the right foot, but moving both lower extremities, and with intact sphincters. There was no evidence of hydrocephalus.

The operation was performed within the first twenty-four hours of life and took two hours and fifteen minutes. At operation the sac was found to be an enlargement of the central canal of the spinal cord which flattened out into a cyst-like structure at the lower end. There was no dura. The parchment-like part of this sac was resected and the remainder folded in. Since there was no dura, the closure consisted of a transplant of fascia lata and skin.

Five and a half months postoperatively the child held its head up normally, sat up with support and all of his reactions appeared normal for his age. The head size was 15 inches, the chest 14 inches. The fontanel was not tense and the pediatrician reported no evidence of hydrocephalus. The sphincters were intact and the lower limbs moved with good strength and coordination. (Fig. 13.)

CASE VII. Baby C had a directly exposed cord and cauda without a covering sac. The

11 12

FIGS. 11 and 12. Baby T.

FIG. 13. Baby G.

child was delivered in a breech position and as the back passed under the symphysis pubis, both cord and nerves were rubbed raw and bleeding. At first examination the neural elements were plastered down tight with dried blood. There was no movement in either lower extremity, both of which appeared limp and blue. The sphincters were questionable. (Fig. 14.) The child was a 7 pound, 11 ounce full term male delivered by version. He was operated upon nine hours after birth, the operating time being almost two hours. At operation the lower end of the cord was found to be bifid. Its lateral edges appeared to merge into the skin on either side but it was found it could be separated from skin by blunt dissection. Then it was folded in to make a more nearly cylindrical mass.

Closure was extremely difficult. It was necessary to transplant fascia lata, undermine skin and use relaxing incisions. (Fig. 15.)

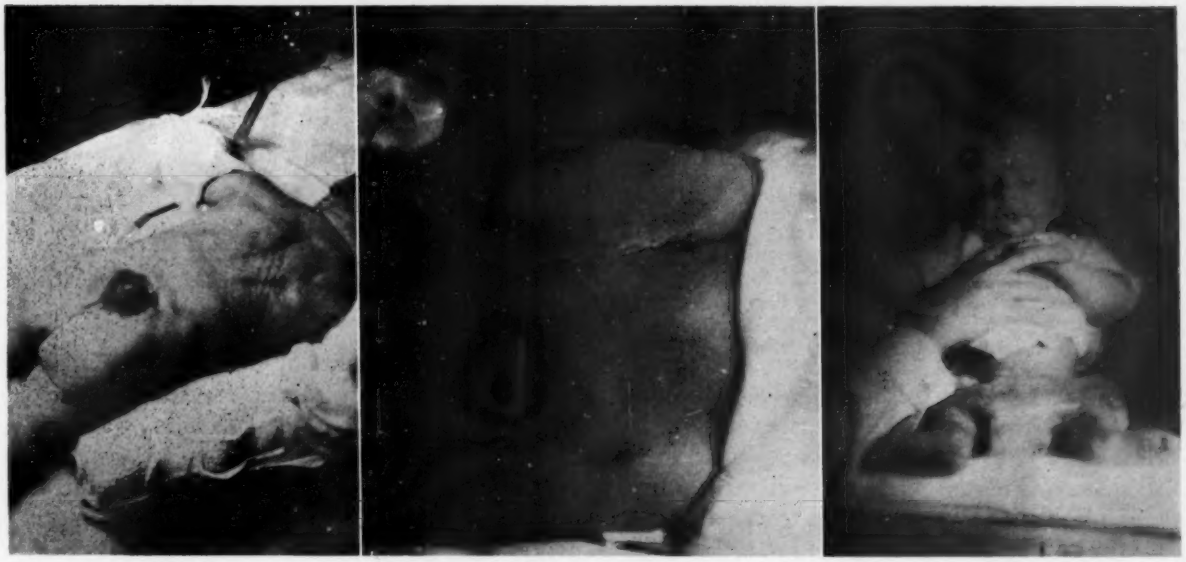
When seen four months after surgery this baby was moving both lower extremities well although the left was slightly spastic and the foot held everted. The head diameter was the same as the chest, 15½ inches. The anterior fontanel was soft and there was no evidence of hydrocephalus. The sphincters functioned well. The family doctor believed the child to be developing normally. (Fig. 16.)

CASE VIII. Case VIII is almost an exact counterpart of Case VII except the outcome has not been so fortunate. The infants were delivered only fourteen days apart in the same hospital and both had exposed spinal cord in almost exactly the same area and to almost exactly the same extent. The child in Case VIII, however, did not suffer the contusion to the neural elements that the other child did; in fact, its cord appeared in much better shape.

Baby B was a 7 pound full term female moving both extremities well but there was a question as to whether the bladder sphincter was competent. At operation the cord in this case was not bifid but it did appear to merge with the skin at its lower end from which it could not be separated by blunt dissection and had to be cut away. Furthermore, the filum terminale in this case was not identified and therefore was not cut.

Within a month of the operation the child was definitely hydrocephalic, the sphincters incompetent and development unsatisfactory. Four months after birth the child's head measured 18 inches in diameter. This case must be considered a complete failure.

CASE IX. Baby Lin. had a large lumbo-



14 15 16

FIGS. 14, 15 and 16. Baby C.

sacral meningomyelocele, sessile base, associated with marked kyphosis beneath the defect. At operation the bony canal was entirely absent; and when the cord was freed up, there was no trough to drop it into. Consequently, the fascial transplant necessarily compressed it to some extent. Hydrocephalus was evident within two weeks after surgery and postmortem examination at eight months showed a typical Arnold-Chiari complex.

CASE X. Baby H had a defect which was not nearly as large as many of those handled successfully. It was a meningomyelocele, thoracolumbar in position, with a part of the cord exposed on the surface of the sac. Spinal fluid was oozing from this area. The infant was a 5 pound, 7 ounce female eight months old who had been born prematurely. She had an unusually sloping forehead and poor control of the lower extremities. There was kyphosis of the spine.

At operation the cord was separated from the sac by sharp dissection and a new dural canal fashioned. With a fascia lata graft and some undermining, fascia and skin were closed without tension. After surgery, which required two hours, the child moved the lower extremities well and the sphincters were intact. The result of operation appeared good. Eight days postoperatively, however, enteritis with frequent stools quickly developed and the child suddenly died. No postmortem examination was done.

SUMMARY

A technic for operation of myelocele and meningomyelocele in early infancy has been prepared. That the newborn withstand such surgery well has been demonstrated. Ten cases in which patients were operated upon with this method have been described, with seven good results. Of these seven, two that had shown evidences of hydrocephalus appeared to have had the condition arrested following surgery, while one who could move neither leg before operation now moves both these extremities well. Although the results are too early for final conclusion, they are encouraging.

PROTRUSIONS OF INTERVERTEBRAL DISCS

STUDY OF THEIR DISTRIBUTION, CHARACTERISTICS AND EFFECTS ON THE NERVOUS SYSTEM

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THIS investigation was undertaken in view of the recent emphasis on lesions of the intervertebral disc in the etiology of low back pain, shoulder pain and associated disorders.[3] The normal anatomy and embryology of the intervertebral disc and adjacent structures have been well worked out.[5,20–21] The studies of Schmorl,[23] Andrae[1] and many others following their lead[6–8,12,18,20,24,25,28] have demonstrated numerous facts regarding the pathologic anatomy of disc lesions. In these investigations thoracic, lumbar and lumbosacral discs have been emphasized to the practical exclusion of cervical levels.

In view of the increasing incidence of the clinical diagnosis of the cervical disc syndrome,[4,9,13] there is need for investigations of the anatomy of lesions of the cervical disc. In addition, no systematic study correlating protrusions of cervical intervertebral discs with possible alterations in the spinal cord and associated sensory roots is available. The objective of this investigation has been to contribute to remedying these deficiencies.

MATERIALS AND METHODS

The spinal columns and cords used in this study were obtained from cadavers dissected in the gross anatomy course during the past four years. Following laminectomy, the spinal cord and its covering meninges and attached nerve roots were carefully removed from the vertebral canal. The latter was then examined for protrusions of the intervertebral discs. The extradural fat, venous plexuses, and when necessary, the posterior longitudinal ligament were dissected away at sites of protrusions and the involved disc or discs plus halves of the adjoining vertebral bodies isolated with transverse saw cuts. In the majority of cases these pieces were then divided into right and left parts by sawing them in a sagittal plane. In the later stages of the study, portions of the spine showing protrusion were frozen prior to being cut in transverse and sagittal planes.

The foregoing preparations readily permitted exact measurement (millimeters) of the height of the protrusions and the thickness of the involved discs. They were also ideal in connection with noting breaks in the annulus fibrosus, displacement of the nucleus pulposus, vertebral lipping, and finally, the exact location of the protrusion. In addition to the aforementioned data, measurements of the stenosis of the intervertebral foramina were made in several instances. This was accomplished by entering a gradually tapered rod into a foramen involved by a marked intervertebral disc protrusion and comparing it with its normal contralateral counterpart.

Segments of the spinal cord corresponding to levels of protrusion were isolated for histologic preparation and study. Four serial transverse sections (paraffin method) were saved at 1 mm. intervals and mounted individually on separate slides. The slides were stained according to the methods of Weigert (myelin), Bodian (silver for neurons including processes), Einarson (perikaryon and Nissl granules) and Delafield (general features). In six cases the nerve roots and ganglia were dissected from markedly stenosed intervertebral foramina, treated according to the Marchi technic for degenerating myelin, and complete serial sections of each prepared for study.

In the large group which showed unilateral protrusions we have used the unaffected contralateral side as the control. In cases of bilateral or median protrusions the nearest uninvolved segments below the sites of involvement served as controls. Compression of the intervertebral discs has been assessed by comparing the involved disc with normal discs of the same level.

Extreme caution has been used in interpreting the histologic findings. Only well fixed preparations have been used and all changes

described have been limited to associated intervertebral disc alterations.

RESULTS

Incidence of Intervertebral Disc Protrusions. In this study a total of ninety-nine spinal columns have been studied. Of this number sixty-three showed one or more protrusions of the intervertebral disc. In fifty-three cases cervical levels were involved. (Fig 1.) Protrusions of thoracic intervertebral discs were found in seven cases. The spinal columns of twenty-seven had protrusions of lumbar discs. Involvement of both cervical and lumbar intervertebral discs in a single specimen was of common occurrence (36 per cent), and we studied two cases in which protrusions were found at cervical, thoracic and lumbar levels in each specimen. From this it is evident that protrusions are most common in cervical, less so in lumbar and quite rare in thoracic levels of the spinal column. Thoracic protrusions were associated in two of the cases with marked thoracic scoliosis. A third case showed prominent asymmetry of the body of a vertebra and other features suggesting compression fracture. Except for a single case of lower cervical compression fracture, cervical and lumbar protrusions occurred without associated changes in spinal curvatures and symmetry that were obviously evident.

TABLE I
INCIDENCE OF MULTIPLE INVOLVEMENT IN SPINAL COLUMNS STUDIED

Region of Spinal Column	No. of Discs Involved			
	1	2	3	4
Cervical	9	15	23	6
Thoracic	5	1	..	1
Lumbar	12	11	4	..

Number of Discs Involved. The data regarding single and multiple involvement of the intervertebral discs in individual specimens of the entire series are summarized in Table 1.

In general the results show that multiple involvement is relatively frequent at cervical, less frequent at lumbar and rare at thoracic levels of the spinal column. We have checked spines having multiple cervical protrusions and lumbar involvement and find that in such spines the lumbar protrusions are as often single as they are multiple. However, in specimens showing multiple lumbar protrusion, concomitant cervical involvement is more often multiple than single. Thoracic protrusions were not accompanied with intervertebral disc changes at other levels in 71 per cent of the cases studied, and the small number which were, presented the same type of picture seen in the cervicolumbar group.

TABLE II
DISTRIBUTION AND SIZE OF INTERVERTEBRAL DISC PROTRUSIONS

Level	1 to 2 mm.	2 to 4 mm.	4 to 7 mm.	Total
Cervical	62	37	27	126
Thoracic	6	3	2	11
Lumbar	17	12	17	46
Total	85	52	46	183

Size and Distribution of Intervertebral Disc Protrusions. The size of the protrusions seen permits classification into three categories, namely, small, 0 to 2 mm.; medium, 2 to 4 mm. and large, 4 to 7 mm. The distribution of these three types is presented in Table II.

Of the three sizes of protrusions studied, 46 per cent were small, 28.4 per cent were medium sized and 25.2 per cent were large. In line with findings in Table 1, cervical protrusions are most numerous. Of these nearly half are small, less than a third (29 per cent) medium sized and the remainder large. In the lumbar region, on the other hand, small protrusions form 37 per cent, medium sized, 26 per cent and large, 37 per cent of the total number occurring at that region.

Size of Protrusion and Compression of the Associated Intervertebral Disc. In the majority of protruding discs encountered in this study measurements of thickness of the disc in the mid-sagittal plane have been recorded. Since the disc is shaped somewhat like a biconvex lens, three measurements were taken. Anterior thickness was measured adjacent to the anterior longitudinal ligament, middle thickness opposite the central axis of the vertebral centra and posterior thickness in line with the posterior margins of adjacent vertebral bodies.

The percentage compression was computed by comparing the average of the three thicknesses with a figure obtained in the same way from measurements of normal discs. The data obtained in this part of the study are summarized in Table III.

TABLE III
SIZE OF PROTRUSION AND COMPRESSION OF INTERVERTEBRAL DISC

Disc	Percentage Compression: Height of Protrusion				
	2 mm.	3 mm.	4 mm.	5 mm.	6 mm.
C_3	33	29	18	..	..
C_4	19	22	32	..	..
C_5	33	34	33	10	..
C6	35	35	33	75	..
C_7	..	27	..	..	66
T_7	42	..	..	..	..
T_{10}	..	11	..	..	..
L_1	11	..	..	..	..
L_2	..	39	..	..	..
L_3	..	8	..	11	..
L_4	16	33	41	..	25
L_5	49	..	51	36	..

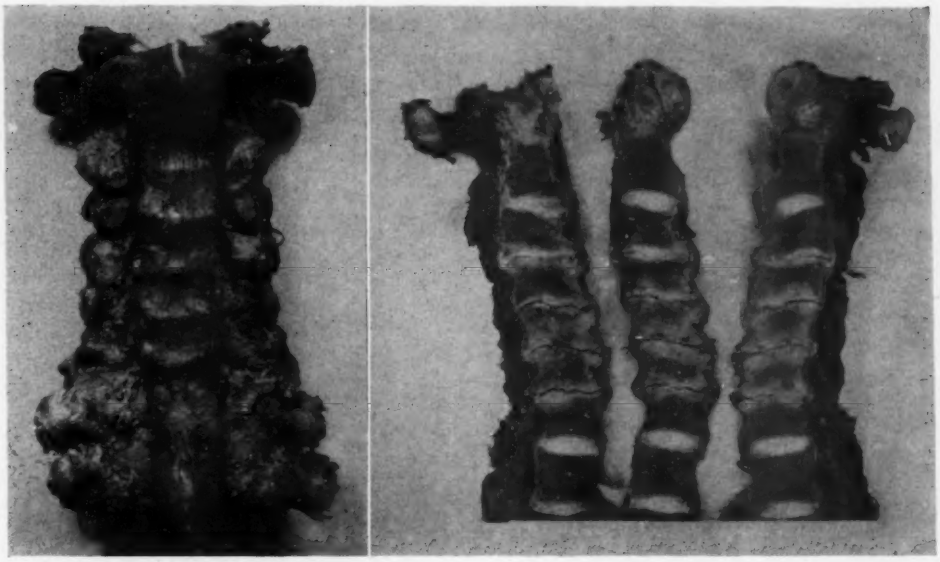
It is evident from these data that there is no regular association of the size of the protrusion and amount of compression of the intervertebral disc. Some small part of this lack of correlation is probably associated with rather widespread variation in the number of cases available for analysis in the various categories listed. Thus the 35 per cent compression associated with 3 mm. protrusion of C6 disc represents the average of measurements on fourteen cases. A 5 mm. protrusion of the C_5 disc was observed in only one case, and it is quite possible that the 10 per cent compression observed in this instance might have been different had more cases been available for measurement. There is a further possible source of error. The smaller dimensions of cervical discs as against the lumbar variety make exact measurement of the former more difficult than the latter. In spite of the features which detract from statistical treatment of these data, we believe that the main reason for the observed lack of correlation between percentage compression and height of protrusion is found in the variation in the types of protrusions seen. Thus in single nodular herniations the amount of compression is usually from 10 to 35 per cent. When the extruded mass assumes the form of a ridge, the compression lies within the range of 30 to 70 per cent in the majority of cases.

In two cases showing marked cervical protrusions (Fig. 2) little or no remnant of either the nucleus pulposus or annulus fibrosus was found between the adjacent vertebral bodies. The latter were deformed by prominent lipping with the result that prominent transverse ridge-like protrusions encroached on the intervertebral foramina and vertebral canal. (Fig. 1.) We have not observed this extreme condition at lumbar levels.

Distribution of Cervical Intervertebral Disc Protrusions. For reasons indicated before, it seemed important to emphasize cervical protrusions in this study. Many facts regarding this type of protrusion are summarized in Tables I to III. They do not, however, inform us regarding the distribution frequency of protrusions within the cervical region. Considering protrusions of all sizes, we found forty-two (33 per cent) associated with the fifth cervical disc; thirty (24 per cent) at the fourth; twenty-seven (22 per cent) at the sixth; fourteen (11 per cent) at the third; eight (6 per cent) at the second and five (4 per cent) at the seventh cervical disc. When protrusions 4 to 6 mm. high are considered by themselves, fifteen (55 per cent) occur at the sixth cervical disc and twelve (45 per cent) at the fifth.

Decrease in Size of Intervertebral Foramina. Inasmuch as there is a marked tendency for the intervertebral disc to protrude posterolaterally, it is of interest to determine the amount of encroachment on the nearby intervertebral foramina. Data regarding narrowing of the intervertebral foramina were obtained from the last seventeen spines studied. In this group we found stenosis to range from 20 to 40 per cent. The control foramen in each case was the uninvolved contralateral counterpart of the narrowed foramen. The important factors in determining this reduction were the size of the protrusion, its proximity to the intervertebral foramen and the amount of compression of the disc. We suspect that had this aspect of the study been commenced earlier, we would have encountered even greater encroachment because the largest protrusions were not represented in the analysed group.

Alterations in the Disc in Cases of Protrusion. When the disc itself is examined for changes



1 2

FIG. 1. Posterior view showing marked multiple protrusions in the cervical region; No. 65.
FIG. 2. Sagittal sections showing slight (C_3) and extreme (C_4, 5 and 6) changes in intervertebral disc; note that virtual absence of the disc in latter group is accompanied with prominent lipping; No. 65.

incident to protrusion, it is commonly observed that the annulus fibrosus is torn through the greater part or all of its thickness at some point along the posterior aspect of its circumference. (Fig. 3.) The nucleus pulposus shows decreased dimensions which are associated with extension of part of its substance through the rupture. The amount remaining is variable. Cases showing complete extrusion are comparatively rare. Occasionally, small pieces of nucleus pulposus are found along the path delineated by the break. The breaks are usually posteromedian or posterolateral in position. The resulting protrusions are similarly located in the majority of specimens. Lateral rupture and lateral protrusion form the most common combination and usually result in a circumscribed conical mass which encroaches on the intervertebral foramen. About 40 per cent of all lumbar protrusions fall into this group. When the rupture is median, one finds either a localized conical mass covered by the posterior longitudinal ligament or a ridge-like protrusion extending across the greater portion of the posterior aspect of the disc. The ridge itself may show asymmetry with small nodular elevations anywhere along its course but especially near one of its lateral ends. In other specimens the ridge may encroach markedly on one intervertebral foramen and run out before reaching the contralateral foramen. Various combinations of these asymmetric features are seen in individual specimens. The cervical region is a particularly common site for protrusions of this sort. (Figs. 1, 4 and 5.)

In addition to these cases showing rupture, one frequently finds marked protrusions in which no break can be demonstrated. In these cases the annulus fibrosus appears stretched and thinned out. Its diameters exceed those of the adjacent vertebral centra. The stretched annulus invaginates the posterior longitudinal ligament and a ridge-like protrusion is found to extend across the greater part of the anterior wall of the vertebral canal. This is the characteristic picture in cervical protrusions when no break is demonstrable in the annulus fibrosus. (Figs. 4 and 5.) In the lumbar region, probably because of the greater restraint of a better developed posterior longitudinal ligament, the stretched annulus usually forms a rounded protrusion. Transverse sections through lumbar discs reveal that the thinned annulus has buckled into the gap between the posterior longitudinal and oblique ligaments of the spinal column.

Neurohistologic Study. The final objective of our study has been to determine what were the effects, if any, of protrusions on the spinal cord and its attached nerve roots. Satisfactory transverse cord sections of the first twenty-two cases were not obtained mainly because of a

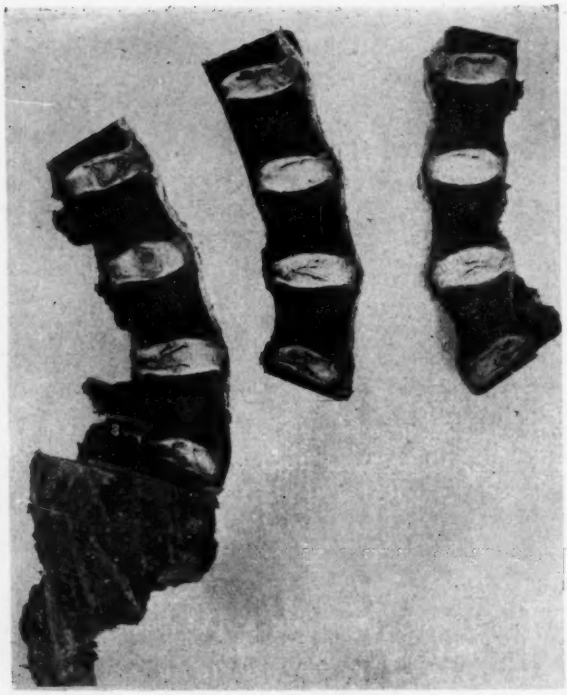


FIG. 3. Sagittal sections showing protrusions of L_4 and L_5 (lumbosacral) discs; note the breaks or fissures through the annulus fibrosus; No. 56.

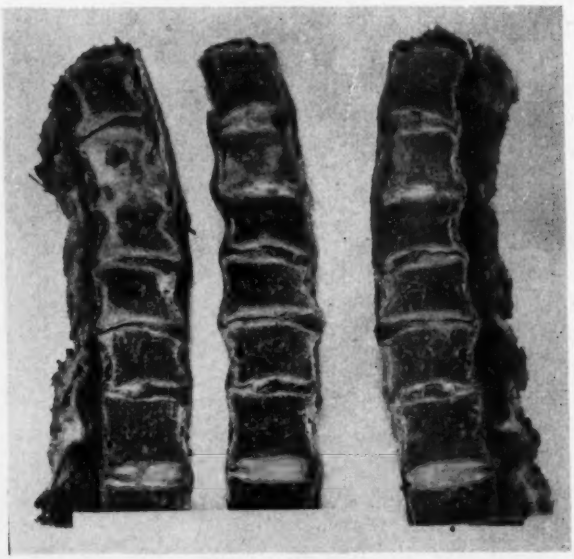


FIG. 4. Sagittal sections showing protrusions of C_4 to C_7 discs; C_4 and C_7 show no rupture of the annulus fibrosus; C_5 and C6 show rupture and in C6 remnants of the nucleus pulposus are located anteriorly; No. 64.

colored starch mass having been injected to facilitate the student's identification of arteries in routine dissection. This injection mass was omitted thereafter in the interest of the problem. Postmortem autolysis, a change to which the gray matter in the central nervous system

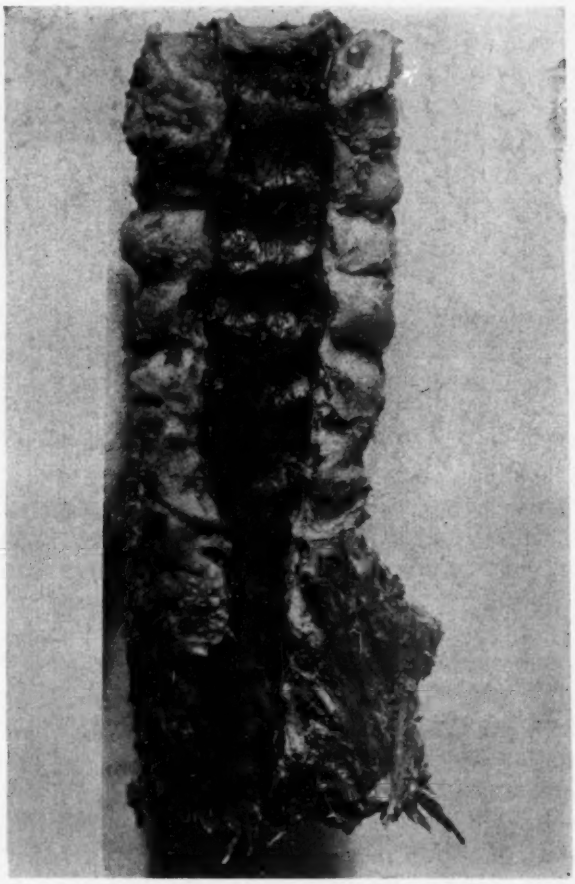
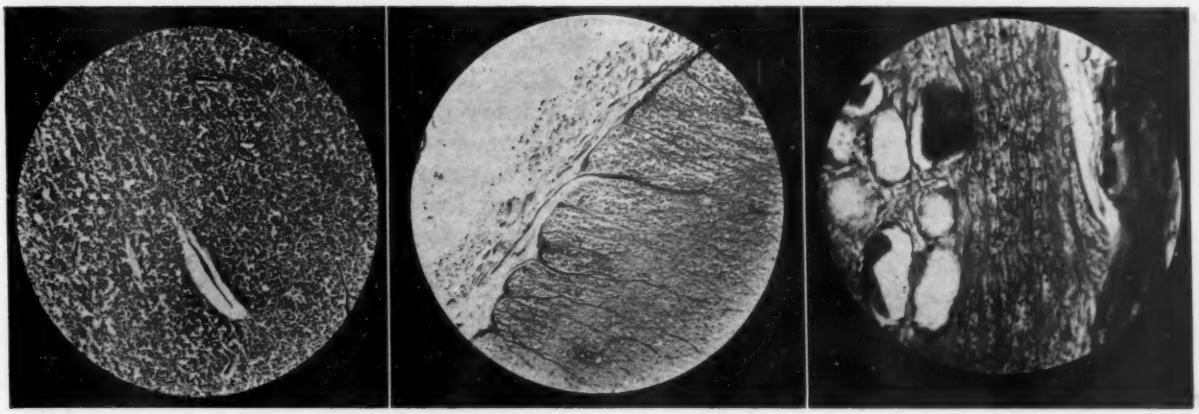


FIG. 5. Posterior view showing multiple cervical protrusions; No. 64.

is susceptible, made further discards necessary. Of the fifty-six spinal cords from which segments were saved for study, twenty-one showed good fixation and staining. In five of these the cytologic details were exquisitely portrayed.

The most obvious change that has been encountered in the histologic preparations was a reduction in the number of axons in the fasciculus cuneatus (Fig. 6) and dorsal spinocerebellar tract. (Fig. 7.) This is especially evident in six cases in which several cervical intervertebral foramina have been narrowed by disc protrusions. As is to be expected, the reduction becomes progressively more marked as sections are taken in order from lowest toward the highest of the involved segments. Confirmation of this observation has been obtained from studying Marchi preparations of the affected posterior roots. These show evidence of scattered degeneration. (Fig. 8.) In many cases it appears to be limited to the myelin of the axis cylinders. In some the cell bodies of the ganglia are deformed as well.



6 7 8

FIG. 6. Photomicrograph showing greater axon density in fasciculus gracilis (right) than in cuneatus (left) in case with multiple cervical protrusions. Part of the posterior intermediate septum is seen between the fasciculi; × 100. Bodian protargol, No. 63, C1.

FIG. 7. Photomicrograph showing ischemic degeneration and moderate astrocytosis in dorsal spinocerebellar tract; × 100. Einarson gallocyanin, No. 47, C8.

FIG. 8. Photomicrograph showing ganglion and myelin degeneration in the sensory root. Intervertebral foramen stenosis; 25 per cent, × 430. Marchi osmic acid, No. 63, C4 right.

We have been unable to detect any marked increase in the satellite cells of the ganglia.

Dorsal spinocerebellar tract degeneration was found to be associated with stenosis and in some cases occlusion of spinal branches of the vertebral artery or aorta as they traverse the intervertebral foramen and reinforce the anterior and posterior spinal arteries. Normally, these branches follow the roots to the superficial parts of the spinal cord. From our observations it appears virtually certain that the branch of the spinal artery traversing the sensory root en route to the posterior spinal artery supplies the area of the dorsal spinocerebellar tract before joining the latter. The degeneration seen in this area is thus well explained on the basis of a partial ischemia.

In addition to the foregoing degeneration, transverse sections of the spinal cord show a moderate localized astrocytosis. This was evident in the fasciculus cuneatus, dorsal spinocerebellar tract and was particularly marked at the region of entry of the posterior sensory roots. The astrocyte increase probably represents an attempt by these supporting elements to compensate for the structural defect resulting from axon degeneration in these areas. However, its occurrence at the point of root entry may be partially attributable to factors not evident from this study. It should be noted in passing that amyloid bodies (Fig. 9) were particularly abundant at the site of dorsal (posterior) root entry in cases of intervertebral disc protrusions. However, since we have observed that amyloid bodies are rather widely distributed around the periphery of the cords of specimens completely devoid of intervertebral disc protrusions, we feel reticent about associating their presence with disc protrusions, even when their distribution is limited to the site of entry of the sensory root.

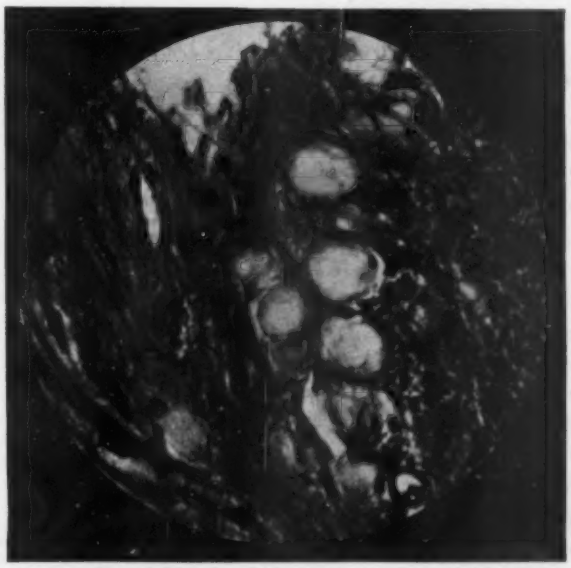


FIG. 9. Photomicrograph showing amyloid bodies at medial side of zone of dorsal root entry in a case with marked cervical protrusions; × 900. Weigert hematoxylin, No. 54, C2.

Dorsal column degeneration at lumbar levels has been difficult to detect. Probably the main

reason lies in the fact that concomitant involvement of three or more foramina in a given case is infrequent, and the additive effect which helped so much in detecting degeneration in the cervical region is absent or minimal here. We do not, however, wish to imply that lumbar degeneration does not occur. Since no Marchi preparations of lumbar sensory roots were prepared, it is necessary to defer final decision on this point.

With the exception of pial thickening, we have been unable to associate any cord changes in cases of protrusions impinging on the vertebral canal. This cavity must be sufficiently large in relation to the size of the contained cord, and the extradural fat sufficiently amenable to displacement, to compensate for such protrusions as were found in this study to encroach upon it.

COMMENTS

In this investigation we have found that demonstrable protrusions of the intervertebral discs occurred in 63 per cent of the specimens studied. This is a high percentage, especially in the light of Andrae's finding the incidence 15.1 per cent in his analysis of fifty-two routine autopsies and Horwitz' figure of 16 per cent in a study of seventy-five cadavers. The discrepancy is partly explained by the fact that Horwitz dealt with the lumbar spine only. In our series lumbar protrusions were seen in only 27 per cent of the cases. The high total incidence is mainly due to the great frequency with which we found the cervical region involved. It appears that Andrae's series was far from typical. Thus he reports four cervical, seventy-seven thoracic and twenty-five lumbar protrusions. The intervertebral discs from the ninth thoracic to the first lumbar segment accounted for nearly half of the protrusions. The great discrepancy between these findings and those of a large number of subsequent investigators shows that Andrae's series was atypical in respect to the location of disc protrusions. It seems likely that it was also atypical in respect to the incidence of protrusion.

Before leaving this matter of incidence it should be pointed out that we have meticulously recorded even the smallest protrusions. This appeared to be our only course, because a large number (37 per cent) of the spines studied were perfectly smooth, without an abnormal excrescence of any kind impinging on the intervertebral foramina or spinal canal.

There is the possibility that some few of the protrusions recorded are in reality artifacts, incident to a variety of factors, such as rigor mortis, the embalming procedure, handling the body by students during their general dissection and trauma associated with performing the laminectomy. It must be remembered, however, that the laminectomy itself, and the previous dissection of the body by the students, free the intervertebral discs of muscles and ligaments that tend to compress them. In the absence of these restraints the height of the protrusions would be reduced. One can demonstrate that this is the case even though the tissues are fixed. Considering the problem in its entirety, it appears correct to minimize the importance of artifacts.

We do not wish to construe from the previous reference to small protrusions that they are necessarily silent. In view of the shape and position of the intervertebral foramina, this may not be the case. According to Bradford and Spurling[3] these foramina are ovoid to rectangular in the cervical region. Their long dimension is directed supero-inferiorly. The anteroposterior dimension is short and forms a snug fit for the nerve roots and ganglia. A small protrusion placed close to the foramen might as readily compress the nerve roots and ganglia as one which is larger and more medially located. The precise location of the protrusion is important in assessing the amount of insult to the nervous system. In conformity with this view we have found degeneration in one sensory rootlet when the associated protrusion measured 2 mm. in height.

The ratio of cervical to lumbar protrusions does not agree with the findings of earlier investigators. Andrae reports 8 per cent incidence of cervical protrusions in routine autopsies; Bradford and Spurling[3] estimate that 4 to 8 per cent of all herniations are cervical, an incidence of less than 1 per cent using the same basis as Andrae. In our series the incidence was 53 per cent. It is probable that the estimate 4 to 8 per cent was based on the number of cases reported in the literature. Many cases have not been reported.[10] The situation is changing rapidly as more and more attention has been drawn to the cervical disc syndrome.

There is another possibility which may help to explain the aforementioned discrepancy.

It is conceivable that protrusions of the intervertebral discs might cause the familiar "stiff neck" or "crick in the neck." Tilting the head and neck usually relieves the symptoms. The maneuver may alter the position of the nerve roots in the intervertebral foramen or favor the reduction of the protrusion itself, so that encroachment on the nerve root would be corrected. Thus the physician would in all probability not be consulted. If this postulate is actually the case, it would be comparatively easy to account for the high incidence of cervical protrusions seen in this study.

Multiple cervical involvement has been frequently seen in our series. It would seem that this state of affairs neatly fits the usual clinical report of pain reference to several rather widely separated foci. Yet it is rare to find clinical reports of multiple cervical protrusions.[3] One naturally wonders whether the concept of single cervical involvement is not largely attributable to the limited exposure which is necessary in cervical disc surgery. It is generally conceded that the prognosis of patients with cervical protrusions is not good, on the whole. While there are undoubtedly many factors to be considered in this connection, the possibility of multiple protrusions should not be disregarded.

The distribution of cervical protrusions correlates reasonably well with results reported in the clinical literature. Considering protrusions of all sizes, the fifth cervical disc (sixth cervical nerve) was most frequently involved. Intervertebral discs 4 and 6 followed closely, implicating the fifth and seventh cervical nerves, respectively. These results bear out Stookey's[26,27] correlation of the predominant occurrence of protrusions at mid-cervical levels with its greater mobility at that part. When protrusions 4 to 6 mm. high are considered, the sixth cervical disc is more frequently involved than the fifth. It is interesting to note that Bradford and Spurling report similar findings.

Young[20] and Semmes[22] have pointed out that x-ray studies of aberrations in the normal curvature of the spine and compression of the intervertebral discs are helpful in diagnosing lesions. In our study it has been observed that the height of the protrusion does not regularly correlate with the degree of compression. In addition to this, many protrusions fail to provoke symptoms not only because of their size and location but also because of the transverse course of the cervical nerve roots. Young's caution of combining x-ray diagnosis with neurologic findings is especially pertinent.

The correlation between aberrations in the normal curvature and rupture of the disc has been exploited by several investigators, the first of whom was Schmorl.[23] In agreement with Schmorl's work we have found thoracic protrusions associated with marked scoliosis in two cases. Because of the nature of our material, we have no data to compare with Young's observations on kyphosis in relation to cervical and thoracic disc protrusions.

Our observations regarding lumbar herniations conform in main with those of the majority of a large number of clinical investigators. The lumbosacral disc is most frequently involved, its nearest competitor in this regard being the fourth lumbar disc. Some features described in lumbar protrusions differ from what we have encountered. Horwitz[11] rarely found posterolateral nodular herniations and commonly observed posterior bulging of the annulus fibrosus across its entire width. Our material shows precisely the reverse of this situation, and except for a somewhat higher incidence, corresponds with the findings of Batts.[2]

Localization and dispersal of pain in cases of lumbar and lumbosacral protrusions have been better understood because of Roofe's[19] demonstration of recurrent innervation of the annulus fibrosus and posterior longitudinal ligament. The observations of Naffziger, Saunders and Inman[17] suggest that the roots involved by some protrusions are compressed against the ligamenta flava during their course in the vertebral canal. The compression was found to occur one segment above the level of exit of the involved roots. It thus becomes apparent that a lumbosacral disc protrusion could involve the first sacral rather than fifth lumbar roots.

We have found that the incidence of concomitant involvement of two lumbar discs is as great as for one. In many of these cases the size and location of both protrusions were such as to suggest the possibility of provoking symptoms. We believe it is important to add this possibility to the findings of Roofe, and Naffziger, Saunders and Inman, in considering the problem of localization and dispersal of pain in the lumbosacral disc syndrome.

The changes in lumbar intervertebral discs have been quite uniform. The descriptions of Deucher and Love,[7] Macey[16] and many others

conform with our findings, especially in cases in which rupture of the annulus fibrosus has been demonstrable.

Too little attention appears to have been given protrusions associated with stretching of the annulus fibrosus without rupture. In the lumbar region annular stretching forms a circumscribed rounded elevation which is located in the hiatus between the posterior longitudinal and oblique ligaments of the spinal column. Not infrequently they are calcified. Even when this is not the case, the protrusions are firm and well anchored. They stand in contrast to protrusions associated with complete rupture of the annulus. The latter are composed of portions of the nucleus pulposus, fragments of the annulus fibrosus, and when uncalcified, are of almost friable consistency. The firmness with which these protrusions are anchored depends on the extent of the connective tissue reaction around them. In our experience this appears quite variable. It is probable that these observations are important in relation to the problem of intermittent and continuous symptoms.

Early stages of cervical disc protrusions show no considerable departure from the picture displayed at lumbar levels when rupture of the annulus fibrosus occurs. If the latter does not occur and annular stretching prevails in the cervical region, the protrusion is usually in the form of a ridge. Advanced stages of cervical protrusions show further differences from the lumbar variety. The compression of the disc is more severe. Less nucleus pulposus material can be demonstrated in the protrusion, even though allowance is made for its normally smaller amount in intact cervical discs. The bodies of the vertebrae adjacent to protrusions are sometimes deformed by prominent lipping and thereby make a large contribution to the protrusion. Most of these differences appear to be related to the relatively great mobility of the cervical spine. They attest the importance of early treatment of cervical protrusions.

Systematic studies of the changes in the nervous system in cases showing protrusion of intervertebral discs were entirely wanting when we commenced this study. Recently Lindblom and Rexed[14] wrote on this phase of the problem. As their work deals with lumbar levels and our emphasis has been on cervical levels, we have an introduction to the total problem.

Lindblom and Rexed found some degeneration in nerve roots, ganglia and peripheral nerves. However, they report that evidence of cord degeneration was meager. It seems likely that they encountered the same obstacle as we when dealing with lumbar levels. The low incidence of triple and the absence of quadruple protrusions at lumbar levels is an important factor in making cord degeneration difficult to detect. In the cervical region simultaneous involvement of from three to five discs occurs frequently. The effects of protrusion on the individual nerves are added when cord sections rostral to the sites of involvement are examined for degeneration. We have found degeneration in the fasciculus cuneatus of six specimens, each of which had multiple protrusions. It is difficult indeed to understand Lindblom and Rexed's observation that the central processes of sensory neurons show no degeneration as they traverse the proximal portions of the dorsal roots. All our root preparations contradict this observation.

Degeneration of sensory fibers results in clinically demonstrable sensory deficits in proportion to the amount of degeneration and the amount of peripheral sensory overlap, for example, as seen in the dermatomes. In a few cases with pronounced multiple involvement it seems possible that the amount of degeneration was sufficient to have resulted in peripheral hypesthesia or even anesthesia. It must be admitted, however, that the point remains hypothetical in the absence of clinical history and findings.

In some cases the protrusions irritate rather than destroy the neurons, with the result that paresthesias and hyperesthesias occur. In view of the nature of our material, it would be hazardous to attempt to correlate histologic changes in the neurons with irritative phenomena. We have, however, observed gross evidences of compression of spinal roots and ganglia in some cases which showed no evidence of degeneration. It is quite likely that such protrusions produced irritation with the usual consequences.

Ischemic degeneration in the dorsal spinocerebellar tract alone would not necessarily result in a clinically detectable deficit, inasmuch as it shares the function of conducting proprioceptive excitation to the cerebellum with the well developed and uninvolved ventral spinocerebellar tract. It has usually been our

experience, however, to find dorsal spinocerebellar tract involvement accompanied with degeneration in the fasciculus cuneatus. Some proprioceptive excitation mediated by the latter reaches the cerebellum via dorsal external arcuate fibers. In these cases the possibility of incoordination associated with a deficit in muscle synergy should be considered.

SUMMARY

1. Protrusions of intervertebral discs have been found in 63 per cent of a series of ninety-nine unselected cases (cadavers). Cervical protrusions were seen about twice as frequently as lumbar, which in turn were four times as numerous as thoracic protrusions.

2. In the cervical region the fourth, fifth and sixth discs were most frequently involved. In the lumbar region the protrusions were located at the fourth and fifth (lumbosacral) discs in the majority of cases.

3. Nearly half of the cases showed multiple involvement. It was common in the cervical region, less frequent and extensive in the lumbar region and rare at thoracic levels.

4. The protrusions showed considerable variation in size (0 to 7 mm.). Approximately half were less than 2 mm. high, the rest being about equally divided into medium- (2 to 4 mm.) and large-sized protrusions (4 to 7 mm.) Although large protrusions were found most abundantly at lumbar levels, they were not infrequently seen in the cervical portion of the spinal column.

5. Many of the protrusions (32 per cent) encountered showed no rupture of the annulus fibrosus. The annuli were stretched and bulged at foci where reinforcement was weak or absent. In the cervical region these protrusions were in the form of transverse ridges which encroached on the intervertebral foramina and vertebral canal. In the lumbar region they were nodular and usually encroached on the intervertebral foramen.

6. Most of the protrusions (68 per cent) showed rupture of the annulus fibrosus and extrusion of the nucleus pulposus in whole or in part. The form of the protrusions and points of impingement showed no considerable variation from the aforementioned (5).

7. Compression of the intervertebral disc was greater with ridge-like protrusions than with the nodular variety. It was greater in actively mobile regions of the spinal column than in more stable regions. Markedly compressed discs do not necessarily result in nerve degeneration.

8. In this series damage to the nervous system resulted from protrusions which narrowed the intervertebral foramina. Except for meningeal thickening, protrusions encroaching on the spinal canal failed to produce changes.

9. Degeneration in the fasciculus cuneatus was associated with degeneration in the sensory roots at sites of disc protrusions.

10. The failure to detect degeneration in the fasciculus gracilis is attributed to the low incidence of cases showing multiple lumbar disc involvement.

11. Dorsal spinocerebellar tract involvement is associated with stenosis or occlusion of spinal branches of the vertebral artery or aorta, resulting in a partial ischemia at levels affected by protrusions.

12. There is no simple rule by which the amount of insult to the nervous system can be assessed. Size of the protrusion was important, but certainly also was location, especially with reference to the intervertebral foramen. Finally, the type of protrusion was an important factor in determining damage to the nervous system.

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SECONDARY RENAL OPERATIONS

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SECONDARY renal operation is the exposure of the same kidney the second time, either immediately after the initial operation because of a complication or at some subsequent time. At no time is the dexterity, ingenuity, judgment and experience of a urologic surgeon taxed more than when he is performing a secondary operation on a kidney. The performance of such an operation has been practiced for many years by all urologic surgeons, yet little mention is made of it in textbooks on urology or written by members of the urologic profession. In reviewing the literature only one article was found which deals with the problem and this only indirectly by a Russian physician.[1]

Students in urology frequently ask the following questions: (1) When should a kidney be operated upon the second time; and if it should be operated upon, when should it be a secondary nephrotomy, pyelotomy, partial nephrectomy or other type of operation? (2) On what basis is the decision made to incise the kidney the second time rather than to remove the organ? (3) If a secondary exposure is decided upon, should an extraperitoneal or transperitoneal exposure be practiced? (4) If the kidney is to be exposed the second time, are there any principals to follow relative to its exposure?

The immediate secondary operation on a kidney usually follows the complication of postoperative hemorrhage. This at times occurs following nephrotomy but may occur following any operation on the kidney. The patient manifests the signs and symptoms of shock in spite of all therapy; it may occur in from one to ten days after the initial procedure. If a good functioning kidney is present on the opposite side, a nephrectomy is usually but not always necessary. An interesting case of ours which did not require nephrectomy is as follows: A profuse secondary hemorrhage following a nephrotomy in which oxycel gauze was used resulted in the secondary exposure of the kidney at which time the oxycel gauze was found to have been pushed out of the nephrotomy wound. Replacement of oxycel gauze and suturing controlled the hemorrhage satisfactorily.

If the bleeding point can be located and controlled by either suturing, packing or the use of some hemostatic agent, one does not have to resort to nephrectomy.

We are all quite familiar with the recurrence of calculi in a kidney. The necessity of secondary operations on such a kidney occurs frequently in the hands of the urologist. Whether that secondary operation is to be an incision in the kidney for removal of calculi or for the complete extirpation depends entirely upon the pathologic condition in the kidney, the condition of the kidney to be operated upon, the condition of the opposite kidney, the age and condition of the patient and the experience of the surgeon.

Certainly if the pathologic condition in the kidney which is to be operated upon secondarily is different from the condition for which it had been operated upon the first time (e.g., a secondary tumor, the presence of renal tuberculosis or the presence of considerable infection in a non-functioning kidney), extirpation is quite necessary, especially if a good functioning kidney is present on the opposite side. At times nephrectomy may be necessary in some of these cases in the absence of a good functioning kidney. However, should a kidney be subjected to a secondary operation for a similar condition which necessitated the first operation, judgment must be used as to the necessary procedure. In the presence of a similar condition in the opposite kidney the necessity of preserving as much renal-functioning tissue as possible should be the procedure of choice. Even if the opposite kidney is free from any disease, it may be wise to be conservative unless it is believed that all of the disease cannot be eradicated or that there is great possibility of further recurrence; then it is advisable to resort to more radical surgery such as partial or total nephrectomy.

A number of our patients have been subjected to two, three, four and even six operations on the same kidney only by necessity, that is, the patient may not have been in condition for too extensive surgery or because of fairly good function in the operative kidney. A similar condition may have existed in the opposite kidney or there may have been insufficient renal function to maintain life in the opposite kidney which necessitated conservatism.

In young individuals the necessity of secondary operations on a kidney is important in that frequently the simplest procedure would be primary nephrectomy. However, the possibility of a similar pathologic condition in its mate must be considered. Therefore, in the presence of either a good or bad kidney on the opposite side conservatism is necessary in young individuals. Secondary operations on a kidney for recurrent calculi in patients past fifty years of age should result in a nephrectomy rather than another nephrotomy or pyelotomy providing ample function is present in the other kidney. It goes without saying that many kidneys are exposed secondarily for operative procedures such as life-saving measures for profuse hematuria, complete obstruction in one kidney, total anuria and finally because of a pathologic condition existing in either a congenital or acquired single kidney.

In discussing the question if a kidney is to be exposed the second time whether it should be exposed transperitoneally or extraperitoneally we might begin with the following statement: First, most kidneys that are exposed secondarily are infected and the chance for peritoneal infection is good; therefore, a renal exposure is best. Second, the exposure of a kidney secondarily through the abdomen is not quite as simple as through a renal approach because of the adhesions to the peritoneum following the first operation. There is more chance of damage to the blood supply because of the adhesions than if a renal approach is made. Certainly if one does not contemplate removal of the organ but rather an incision into the pelvis or cortex of the kidney, the renal approach is far simpler than the abdominal approach and less hazardous because the kidney need not be delivered entirely nor the pedicle exposed. The entire operative procedure can be carried on after the convex border or posterior surface of the kidney is exposed. Drainage is certainly preferable through the lumbar route and is also more advantageous. Finally, the urologic surgeon is more familiar with the extraperitoneal structures than he is with the intraperitoneal structures by virtue of his training.

In exposing a kidney secondarily by the lumbar route it goes without saying that it is not quite as simple as the first time it was exposed primarily because of the adhesions. There are more complications that are possible under the best of circumstances than at the primary exposure and one must be able to meet them as they arise. Frequently, because of the complications that may ensue, one is forced to perform an entirely different procedure than what was originally anticipated. Frequently a nephrotomy or pyelotomy was contemplated but resulted in nephrectomy because of complications which arose. It is for these reasons that the opposite kidney must be studied thoroughly before a secondary operation on any kidney is considered.

The common complications that one encounters in secondary operations on the kidney are as follows: (1) opening of the peritoneum not only in one place but also sometimes in several; (2) opening of the pleural cavity; (3) opening into the duodenum or colon, or incision of the liver or spleen; (4) hemorrhage and (5) shock.

The openings that may be made accidently into the peritoneum should be closed immediately without drainage. The same is true of the pleural cavity, colon or duodenum.

If the spleen or liver is accidently cut into, troublesome bleeding occurs and is best treated by placing fat, muscle or one of the absorbable hemostatic gauzes to the area.

The hemorrhage that may result from the exposure may be of three types. The first is that which comes from separating the kidney from the scar tissue and which can be controlled by ligature and is not too troublesome. The second type is that which may come from the cortex of the kidney either by tearing the true capsule of the kidney from the cortex or by direct incision into the kidney. This, also, can be controlled most of the time by the same procedure as was mentioned in controlling hemorrhage from the liver or spleen. The third type of hemorrhage is that which persists after tearing of the capsule or incision into the kidney, or the hemorrhage may come from an unnoticed aberrant vessel which was torn across

or hemorrhage coming from either the renal vein or artery. This hemorrhage is usually more serious and the surgeon is called upon to use his best judgment. If he thinks he can ultimately control the bleeding, so much the better, but if it appears that it might be a hopeless procedure, he is frequently called upon to change his original procedure and perform a nephrectomy rather than some conservative procedure. Frequently he does not have too much time to think about it because of the condition of his patient.

Even when the original secondary procedure was to be a nephrectomy and a great deal of hemorrhage is encountered, rapidity of the procedure is quite necessary, particularly if one of the pedicle vessels has been injured.

The question of shock in patients having secondary operations on the kidney is quite serious. This may come about because of the necessity of pulling on the tissues, particularly the kidney, because of the length of the procedure and because of hemorrhage. In many instances the surgeon is forced to discontinue the operation or change the procedure because the patient has gone into shock. Intravenous fluids and blood transfusions should be started early in these instances to help combat shock and to maintain a fluid balance level which contributes towards shock.

PROCEDURE

Our method of exposing a kidney the second time regardless of the contemplated operation is of two types: (1) to make the incision directly over the first incision excising the old scar; (2) cross the old incision deliberately and disregard the old scar. Personally, the latter is the better of the two because one encounters fresh and undisturbed tissues with less adhesions; a better line of demarcation of the tissues is obtained. The incision is started high and is a modified Israel type. One cannot resect a rib as easily in these cases as in primary incisions because of adhesions to the ribs with a possibility of opening the pleura.

After the original incision is made through the skin, it is advisable to continue one's dissection through the fascia and muscles high in the wound. To avoid opening the peritoneum it is important to work at first in a small area, posteriorly and high. We make a special effort to locate the quadratus lumborum muscle and then to work downward and further posteriorly to the erector spinae muscle. In hugging this muscle one will approach the kidney from the posterior surface rather than the convex border which is quite adherent. After the erector spinae muscle is exposed, the posterior surface of the kidney is palpable. From there one can work upward and anterior and by sharp dissection separate the adhesions from the kidney.

In secondary exposure of the kidney the organ is usually more superficial than it was in the primary operation. If possible it is well to stay outside of the true capsule; this is quite difficult to do in most instances and is not of particular importance if one does not contemplate removing the kidney. If the kidney is to be removed, it can be done more simply with its true capsule on it because, when performed intracapsularly, the capsule causes a thickened pedicle which is to be clamped and tied. In many instances one is forced to perform an intracapsular nephrectomy because the kidney cannot be exposed without stripping the capsule. The smaller the pedicle, the better and safer can the pedicle be ligated.

If the kidney is not to be removed, it makes little difference whether or not the capsule is stripped. The kidney can be incised either on the convex border, posterior surface or even into the pelvis without very much exposure of the kidney. The kidney or its pedicle is frequently friable either because of the pathologic condition present or because of the secondary procedure. At times the entire kidney cannot be exposed and one is forced to remove it by marsupialization. Not too frequently pieces of kidney tissue or a piece of pelvis remains after a secondary nephrectomy and is unavoidable. This should give no great concern with the exception that a longer drainage period follows.

At times, because of the friability of the pedicle, ligatures do not hold causing hemorrhage after a ligature is applied. Reapplication of a clamp or clamps is necessary. One should not hesitate to permit the clamps to remain for three to five days. At times it does not seem feasible to tie the pedicle. Here again it is advisable to permit the clamps to remain for several days.

If a great deal of hemorrhage takes place in a planned nephrectomy before the kidney has been removed, it is particularly urgent to remove the kidney as quickly as possible and the bleeding points can be observed to better advantage. Again, the bleeding may be coming

from the kidney itself and it is important to remove the kidney as quickly as possible even if a planned nephrectomy was not contemplated. Unfortunately, the occasion arises when the pedicle is short and friable, clamps or ligatures do not hold and bleeding persists. At times a finger can be placed over the bleeding point with the application of a clamp. When all of the aforementioned fail, the application of a large gauze pack with pressure may be of service. This should be allowed to remain for several days. In the uncomplicated secondary nephrectomy the tissues are sutured in layers in the usual fashion with drainage. In the uncomplicated cases of incisions into the cortex or pelvis in secondary operations on the kidney the tissues are also sutured in layers in the usual fashion with drainage. Occasionally through-and-through silver wire sutures are used. Postoperative hernias are rare.

Most of our secondary nephrotomies have been closed without a drainage tube in the kidney. A nephrostomy tube was allowed to remain in cases in which we believed better drainage should be established, in which there was a possibility of a small fragment of a calculus remaining or in which we contemplated the use of a solution for dissolution of any calculi. In secondary pyelotomies the pelvis was always allowed to remain open.

At times we have encountered a perinephritic abscess in addition to some pathologic condition in the kidney. The usual procedure was to open and drain the abscess and free the kidney as much as possible, but not to open into the kidney until another time except to open a superficial abscess in the kidney. If it was expected to open the kidney at another time, rubber tissue was usually placed around the kidney to prevent any adhesions and to simplify the next exposure.

Secondary operations on a congenital or acquired single kidney require more care and thought than the cases in which another kidney is present on the opposite side regardless of the pathologic condition. In our experience secondary operations on these kidneys are usually hazardous and are performed only by necessity. When performed the secondary operation is frequently divided into two parts so that too much strain is not placed on the single kidney. The complication here is the possibility of a suppression of urine even if only temporary.

Permanent nephrostomies may be necessary in congenital or acquired single kidneys, especially if stones keep reforming in the single kidney or if it is impossible to remove all the calculi at the time of a secondary operation because of the condition of the patient.

In a series of 1,880 kidney cases recently studied, 308 had bilateral renal pathologic conditions; 25 per cent of these patients were operated upon bilaterally. In this same group eighty patients had more than one operation on a kidney. In one instance a kidney was operated upon six times and its mate four times. Nephrectomy was not performed in this case on either side because of the bilaterality of the disease; the patient underwent a bilateral nephrostomy.

Secondary nephrectomies were performed twenty-eight times for either secondary hemorrhage, recurrent calculi or unsatisfactory result of a pyeloplasty. Immediate secondary nephrectomies were performed ten times for uncontrollable hemorrhage either immediately at the time of operation or one to four days following the original operation. Twelve patients have at present recurrent calculi or calculi which could not be removed at the time of a secondary operation and which may ultimately come to another procedure if they survive long enough. However, some of these have gone on many years without infection or difficulty.

All but four of the secondary operations on the kidney were by the lumbar route, with only one death. The four cases which were done transperitoneally were for nephrectomies, with one death. The surviving patients who have had secondary operations have been followed up from one to thirty years. To say the least, secondary operations on the kidney have caused us more concern and anxiety than any of our other surgical procedures. Careful evaluation of all circumstances involved is of utmost importance and no two cases can be handled alike.

CONCLUSIONS

1. Secondary operations on the kidney are hazardous procedures.

2. No hesitancy should be necessary in performing a secondary renal operation.

3. A thorough evaluation of each kidney is necessary before secondary renal operations are considered.

4. The lumbar route offers a better approach for secondary renal operations.

5. Immediate and late profuse postoperative hemorrhage warrants urgent attention.

6. Conservative renal surgery should be practiced as long as possible.

7. Recurrent renal calculi require a radical procedure, particularly if the opposite kidney is in fair condition.

8. The mortality in this series of secondary operations on the kidney is less than 2 per cent.

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At the Mayo Clinic many patients were said to have cancer of the large bowel in which no such lesion was previously suspected. In many of these cases the correct diagnosis could easily have been suspected if the general practitioner had only done a rectal examination. In other instances, a sigmoidoscopic examination was all that was needed to make a correct diagnosis and, of course, many a family doctor has simply suspected his patient had a "nervous bowel" and prescribed antispasmodic medication for this whereas a complete gastrointestinal x-ray series was what he should have ordered. All of us have made these simple errors, which may prove serious to the patient. Let us remember cancer of the large bowel, especially when confronted with our older patients even though they have only vague abdominal symptoms. Let us not forget that careful rectal examination is as much a part of a complete physical examination as is the vaginal examination. Let us not treat our patients for polyps, colitis, spastic bowel, anemia and appendicitis until we are reasonably sure of our diagnosis and have, when necessary, ruled out any possible growth or other pathologic condition of the large bowel. (*Richard A. Leonardo, M.D.*)

CONGENITAL POLYCYSTIC KIDNEY DISEASE*

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POLYCYSTIC kidney disease is a subject of great importance, since the condition involves both kidneys and ultimately destroys renal tissue, renal function and thus causes death. In the past, many patients never came to the attention of the urologist, and as a result an adequate urologic work-up was never performed. It was considered by physicians that patients with polycystic kidney disease could not be benefited and were treated medically as cases in the terminal stage of the disease. Rovsing[9] in 1911 advocated surgical treatment of patients with polycystic kidney disease. Walters and Braasch[10] in 1934 reported eighty-five patients upon whom surgical intervention was carried out with good results. Goldstein in 1935 introduced a new technic for repeated punctures of cysts by producing a nephrostomized, immobilized kidney.[3] Cahill and Fish in 1941 reported fifty-eight cases of patients with congenital polycystic kidney disease and twenty-three upon whom surgical procedures were carried out with favorable results.[1] In 1946 Young reported the method of sclerotic injection of polycystic kidney following surgical exposure. All of the writers up to this time reported similar results and that the value of the surgical procedures on renal function was limited. When polycystic disease has progressed to a point at which renal failure is due to the disease itself, the prognosis is poor and the results of operative surgery are unsatisfactory. However, when polycystic disease is recognized early and renal function of each kidney is impeded, yet the urea nitrogen is not elevated, these patients may be benefited much more by surgery. More recently the thought has been advocated by some urologists that early surgical intervention might be more beneficial by conserving renal function. A review of fifty-seven cases of this condition is being undertaken with the hope of reaching a better understanding of the symptomatology, diagnosis and treatment. We have attempted to pay special emphasis on the value of the Rovsing operation in reference to increasing renal function. (Table I.) In our series operative procedures were carried out in twenty-four patients. The surgical procedures were nephrectomy, seven cases; incision and drainage of cysts, ten cases; incision and drainage perinephritic abscess, one case and laparotomy, six cases. There was one death due to uremia, following nephrectomy. The patients in this series were from the Urological Service of the New York Post-Graduate Medical School and Hospital, New York, and several cases have been included from Lenox Hill Hospital, New York.

Symptomatology. The age incidence varied. The largest percentage of patients were in the age group of thirty to seventy-nine years. (Table II.) Two patients were seen under the age of one, and one patient was seventy-nine years old. There is a recognized hereditary tendency, as demonstrated by five patients in whom other members of the family were afflicted. In one family, the disease was present in the father, son and daughter. The presenting symptoms are illustrated in Table III. Of these, pain was the most predominant symptom which occurred in seventeen cases. The degree of pain varied in intensity from a dull ache, which was situated in the flank posteriorly or anteriorly, to severe intensity in several patients who had acute renal colic, resulting from an associated blood clot or renal calculus. Gross hematuria as the presenting symptom occurred in eleven cases, and these patients required immediate hospitalization. The degree of hematuria often varied from mild to severe, and several of the patients required repeated transfusions. Bed rest and repeated transfusions were usually sufficient to control the bleeding. However, in several cases surgical intervention in the form of the Rovsing operation was necessary. One patient was seen with a severe hemorrhage from a solitary kidney, with congenital polycystic kidney disease. The other kidney had been surgically removed

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TABLE I

ROVSING OPERATION: TEN CASES OF CONGENITAL POLYCYSTIC KIDNEYS

	Preoperative Findings						Postoperative Findings			End Result
Case No.	Chief Complaint	Physical Findings	Blood Urea Nitrogen (mg. %)	Function in Each Kidney	Preoperative Diagnosis	Operation	Symptomatology	Blood Urea Nitrogen (mg. %)	Function in Each Kidney	Result of Operation
1.	Pain, right flank, 2 years' duration	Comatose	72	Not determined due to poor condition of patient	Congenital, polycystic kidneys	Right Rovsing	Clinically improved for 3 months	59	Unable to determine because of patients condition	Died of uremia 7 months after surgery
2.	Pain, both flanks, 10 years' duration	Acutely ill, marked tenderness in left flank	15	Indigo carmine, none excreted by left kidney in 20 minutes	Congenital polycystic kidneys, calculi in pelvis and upper end of left ureter	Left Rovsing Left pelviolithotomy left ureterotomy	Asymptomatic 2 years after the operation	16	Indigo carmine excreted by left kidney in 10 minutes, 4 concentration	Excellent result
3.	Fever and chills, 4 days' duration	Acutely ill, temperature 102°F. tenderness over left flank	44	Indigo carmine right kidney 4 minutes, 4 concentration; left kidney none excreted in 20 minutes	Left perinephritic abscess	Drainage of abscess left Rovsing	Asymptomatic 8 months after surgery	10	Indigocarmine right kidney 6 minutes, 3 concentration left kidney 15 minutes, 3 concentration	Excellent
4.	Hematuria, recurrent, 3 years duration	Acutely ill, marked anemia, urine grossly bloody	11	Right kidney 10 minutes, 3 concentration; left kidney 8 minutes, 3 concentration	Polycystic kidneys with hemorrhage from left kidney	Left Rovsing	Asymptomatic 8 years after operation	14	Not determined	Excellent
5.	Hematuria, 2 days' duration	Not acutely ill, enlarged left tender kidney	15	Right kidney 6 minutes, 2 concentration; left kidney 12 minutes, 2 concentration	Bilateral, congenital, polycystic kidneys	Left Rovsing 6 weeks later right Rovsing	Asymptomatic 3 years, then attack of right renal colic and hematuria	18	Right kidney 18 minutes, 1 concentration left kidney 23 minutes; 2 concentration	Asymptomatic 3 years
6.	Pain, right flank, and gross hematuria, 3 weeks' duration	Acutely ill, marked anemia, right kidney large and tender	31	Right kidney 17 minutes, 1 concentration; left kidney 30 minutes, 1 concentration	Bilateral, congenital, polycystic kidneys	Right Rovsing	Asymptomatic for 20 months, then admitted into the hospital	105	Unable to determine, due to poor condition of patient	Patient died of uremia 20 months after surgery
7.	Hematuria, 3 years' duration	Not acutely ill, enlarged lower pole of left kidney	15	Right kidney 4 minutes, 2 concentration; left kidney 9 minutes, 2 contration	Bilateral, congenital, polycystic kidneys	Left Rovsing	Asymptomatic 20 months after surgery	16	Intravenous urogram, no dye either kidney in one hour	Asymptomatic renal function poorer
8.	Large abdominal tumor, 1 year's duration	Not acutely ill, blood pressure 200/115	28	Right kidney 6 minutes, 2 concentration; left kidney 12 minutes, 1 concentration	Polycystic kidneys with possible left hypernephroma	Left Rovsing	Stormy convalescence	2 months after surgery 35	Not determined	Patient died of uremia 3 years after surgery
9.	Routine examination, blood pressure 170/100	Not acutely ill, both kidneys palpable	10	Right, 4 minutes, 4 concentration; left 4 minutes, 4 concentration	Polycystic kidneys with possible left hypernephroma	Left Rovsing	Blood pressure unchanged	Patient has not returned for follow-up since dismissal from hospital		
10.	Hematuria, 3 years' duration	Not acutely ill, enlarged right kidney	12	Right, 10 minutes, 2 concentration; left, 8 minutes, 2 concentration	Bilateral, polycystic kidneys	Right Rovsing	Asymptomatic 2 years after surgery	16	Not performed	Asymptomatic 2 years after surgery

at another hospital for congenital polycystic kidney disease. This patient continued bleeding from the residual kidney in spite of bed rest and repeated transfusions. A Rovsing operation was thought inadvisable in this case; this patient was treated with x-ray therapy and the hemorrhage ceased.

TABLE II
AGE DISTRIBUTION

Age (Yrs.)	No. of Patients
0 to 1	2
1 to 9	0
10 to 19	1
20 to 29	1
30 to 39	10
40 to 49	17
50 to 59	14
60 to 69	10
70 to 70	1

TABLE III
PRESENTING SYMPTOMS

	No. of Patients
Pain in flank	17
Gross hematuria	11
Mass in abdomen	7
Uremia	5
Fever and chills	5
Vague abdominal pain	3
Dizziness	1
Dyspnea and edema	2
Weakness	1
Mass in breast (carcinoma)	1
Dermatitis (polycystic kidneys incidental finding)	1
Second degree burns (polycystic kidneys incidental finding)	1
Newborn died at birth, had polycystic kidneys and absence of urinary bladder	1

The physical findings of importance may be enumerated as follows:

1. Albuminuria was the most significant finding on routine examination of the urine. This was noted in fifty of the fifty-seven cases. The urine was normal in only seven of these patients. The albuminuria varied in concentration from a faint trace to large amounts. When there were other findings in the urine in addition to the albuminuria, such as red blood cells or pus cells, much more attention was paid by the examining physician and these patients were referred to the urologist earlier for complete urologic investigation. In patients with only a faint trace of albumin, little stress was paid to this single finding, and urologic investigation was often omitted.

2. Renal function was greatly impaired in 75 per cent of the cases. The degree may vary from mild to severe impairment. Indigo carmine renal function test and phenolsulfonphthalein tests usually show decreased value. In twenty-seven of the cases the total renal function had been greatly impaired, as shown by a marked concentration of the urea nitrogen in the blood.

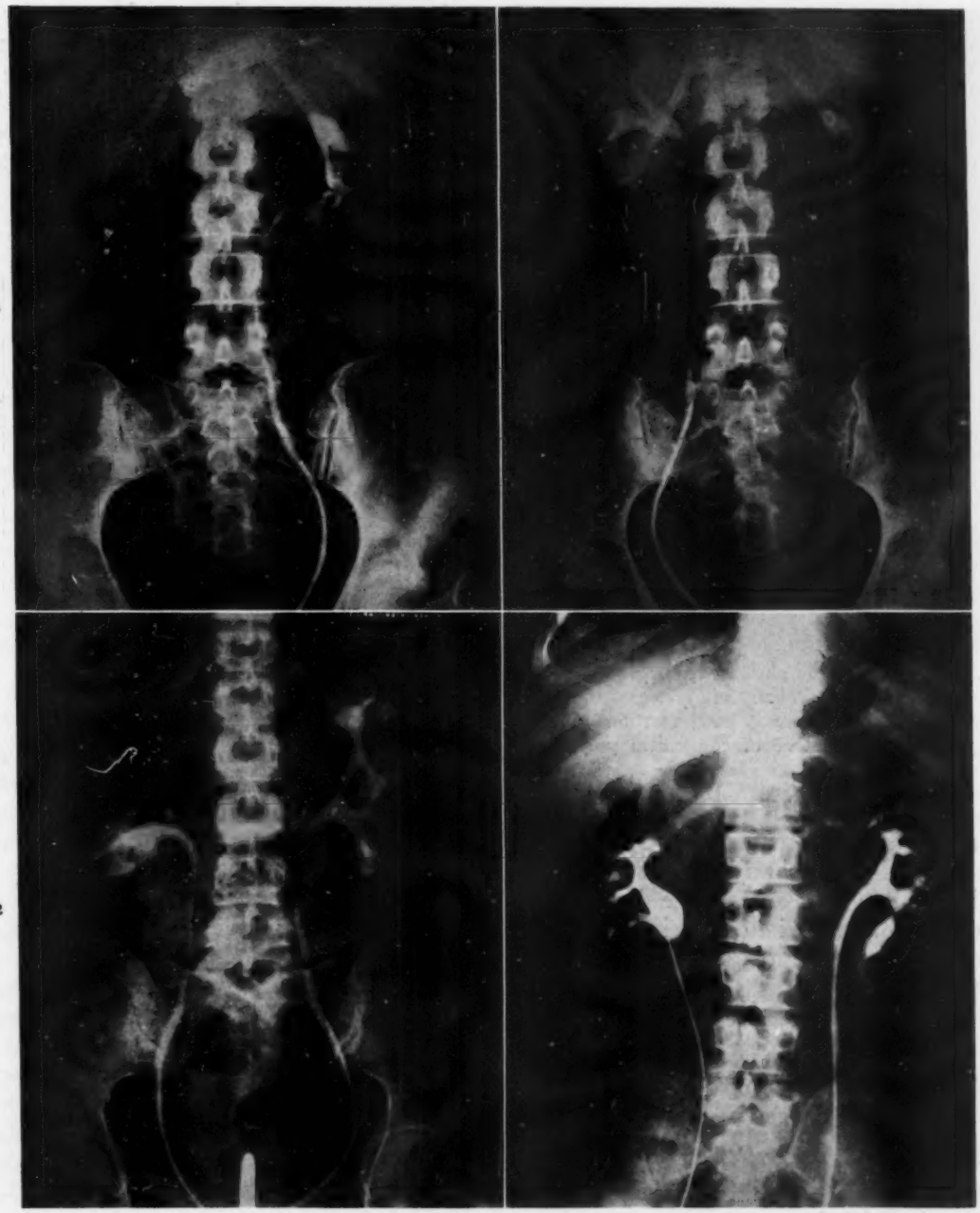
3. A large obvious tumor as the presenting symptom occurred in some of the patients. In twenty cases both kidneys were large and palpable; in thirteen cases only one kidney was enlarged and palpable. In four cases the abdomen was markedly distended and neither kidney could be palpated. In eighteen cases neither kidney was reported palpable nor enlarged.

4. In thirty-five cases the blood pressure was recorded as normal; in twenty-two cases the systolic blood pressure was elevated above 150 and diastolic was above 90.

5. There is little conclusive diagnostic value in intravenous urography. These kidneys have poor renal function, and as a result they excrete diodrast poorly. Therefore, the morphology of these kidneys is poor. A plain x-ray exposure of the abdomen usually reveals the presence of markedly enlarged kidneys, either unilaterally or bilaterally.

6. Retrograde pyelography is by far the best urographic criterion by which diagnosis can be made. There are two main types of urographic findings in polycystic kidney disease. The first type shows abnormality in the pelvis, often called the compression type of pelvis. The pelvis in these cases has a deformity revealing shrinkage with flattening, elongation and tortuosities of the calyces, accompanied at times with calyceal obliteration. These cases are often classified as tumors and are easily mistaken for such, unless the opposite side illustrates typical findings of polycystic kidney. (Figs. 1, 2 and 3.) The second type of deformity is one of bizarre dilatation, which is chiefly localized in the calyces, although the renal pelvis is sometimes affected. (Figs. 4, 5A and 5B.) In these cases the resultant pyelogram shows elongated upper and lower major calyces with gross dilatation and blunting of the extremities, the entire picture appearing to represent the renal pelvis of an enormous kidney.

Infection and calculus formation are fairly common complications of polycystic kidney disease. (Figs. 6A, 6B and 6C.)



1A 1B

2 3

FIG. 1. A, left ureteropyelogram showing filling defect in the renal pelvis; this kidney was removed surgically and found to be a congenital polycystic kidney with associated chronic pyelonephritis. B, right ureteropyelogram showing wide separation of the major calyces highly suggestive of polycystic kidney.

FIG. 2. Right ureteropyelogram showing drooping downward of the pelvis with compression of the superior and middle major calyx; the left kidney shows intrarenal pelvis, elongation of superior and inferior major calyces, compression between calyces due to cysts.

FIG. 3. Left ureteropyelogram showing an enlargement of the lower pole of the left kidney with marked deformity, elongation of the inferior major calyx. Right ureteropyelogram reveals compression of inferior major calyx upward, probably due to a cyst. It was thought that a left renal tumor was present; at operation left kidney was found to be polycystic.

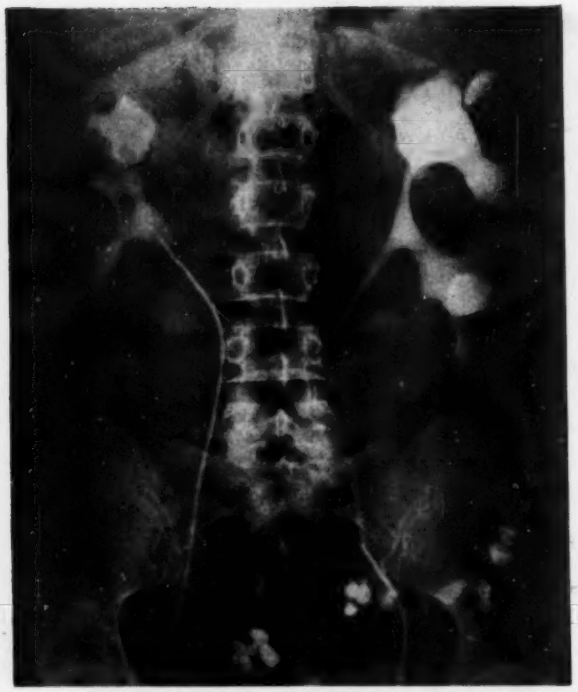


FIG. 4. Flat x-ray of the abdomen reveals markedly enlarged kidneys; bilateral ureteropyelograms reveal markedly enlarged, dilated and tortuous major calyces, findings indicative of congenital polycystic kidneys.

Patbology. These kidneys are usually large. They may extend across the midline of the abdomen and into the bony pelvis so that it is often impossible to palpate the lower pole. The surface of the kidney is irregular and studded with cysts ranging in size from pinheads to those as large as grapes. It is thought that the formation of the cysts is due to the failure of union between the collecting tubules and the metanephrogenic anlage.

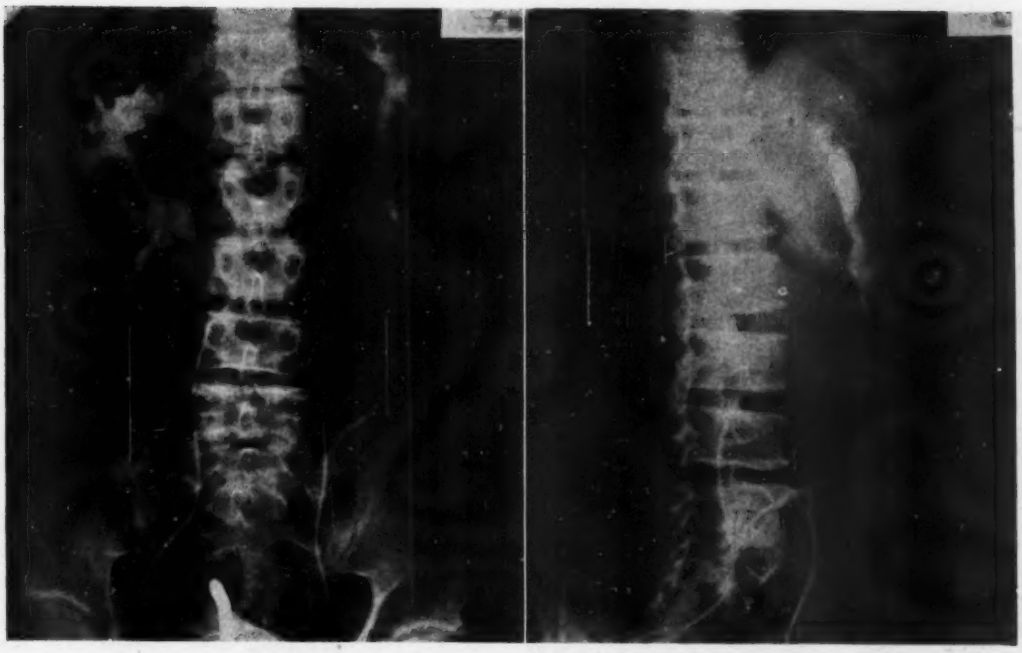
Treatment. The treatment of patients with congenital polycystic kidneys has generally been considered a medical problem and they were treated in the same manner as patients with chronic nephritis. In recent years, however, the greater value of surgical intervention has been recognized. The surgical procedure for each individual case must be evaluated carefully. The general surgeon occasionally encounters congenital polycystic kidneys while exploring the abdomen for what is thought to be another pathologic condition. In this situation it is very important that neither kidney be removed, since the renal status of such a patient has not been determined preoperatively. Such a condition has been encountered in six instances in this series.

Nephrectomy, when performed for congenital polycystic kidney, should be carried out carefully on a well chosen case. The trend should be to conserve renal tissue, and conservative operative procedure should be preferred. The renal function of each patient must be ascertained preoperatively. The presence of an elevated blood urea nitrogen is indicative of renal destruction and, therefore, contraindicates nephrectomy. Severe hemorrhage from a polycystic kidney should be controlled, when possible, by palliative measures, such as bed rest and repeated transfusions. The positive indication for nephrectomy is the presence of an associated pathologic lesion localized to one kidney, such as severe suppurative pyelonephritis, which has not responded to chemotherapy, malignant renal tumor and Goldblatt kidney. In our series of cases (Table IV) nephrectomy was performed on seven patients, with the following pathologic changes: (1) right congenital polycystic kidney and arteriosclerosis; (2) left congenital polycystic kidney, no evidence of function, and preoperatively it was thought to be a renal tumor; (3) left congenital polycystic kidney with associated severe chronic pyelonephritis; (4) left congenital polycystic kidney and hypernephroma; (5) right congenital polycystic kidney with a bleeding vessel in a cyst causing severe hemorrhage; (6) right congenital polycystic kidney encountered at a laparotomy, and thus removed, preoperative diagnosis was chronic cholecystitis; (7) right congenital polycystic kidney in a newborn; it was removed because there was no function

TABLE IV
SURGICAL PROCEDURES ON TWENTY-THREE CASES OF POLYCYSTIC KIDNEYS

Type of Operation	No. of Patients	Operative Mortality	Per cent
Rovsing..... (One patient had numerous calculi removed; one had perirenal abscess drained.)	10	0	0
Nephrectomy.....	7	1*	14*
Exploratory operation.....	6	0	0

*The only death occurred when surgery was performed without determination of the renal function preoperatively.



5A 5B

FIG. 5. A, bilateral ureteropyelograms showing markedly enlarged, dilated renal pelves and elongated dilated superior and inferior major calyces, the findings indicative of congenital polycystic kidneys. B, lateral view of left retrograde pyelogram showing marked elongation of superior and inferior major calyces indicative of polycystic kidney.

in this kidney and pyelographic findings were indicative of a renal tumor.

The Rovsing Operation. The Rovsing operation was performed upon ten patients. (Table I.) There has been much discussion among urologists in recent years as to the value of this operation for the improvement of renal function. It is well accepted that this operation is very useful for relieving excruciating, uncontrollable pain. It will also control hemorrhage localized to one kidney, which has been uncontrollable by palliative measures. In our group of cases this operation was performed specifically for those patients with severe pain localized in one flank or severe hemorrhage from one kidney, either of which was otherwise unreliable. In reviewing these cases we have the opportunity of determining whether this operation was useful in improving renal function.

The Rovsing operation is of little help when performed upon patients with marked renal damage as evidenced by marked concentration of blood urea nitrogen. These patients may improve clinically, but only temporarily. However, the blood urea nitrogen gradually rises to a higher level after the operation, and the patients die of uremia. One patient who had a single congenital polycystic kidney was admitted to the hospital with blood urea nitrogen 72 mg. per cent. A Rovsing operation was performed for severe bleeding from this solitary kidney. The bleeding stopped ten days after the operation. The blood urea nitrogen fell to 59 mg. per cent. However, seven months after this operation the blood

TABLE V
HOSPITAL STAY FOLLOWING ROVSING OPERATION

Operation	Days	Remarks
Rovsing and drainage of perirenal abscess	40	Wound infected and bloody urine persisted after operation
Rovsing and pelviolithotomy	35	Wound infected and bloody urine persisted after operation
Rovsing, eight cases.....	15¾	Average for each case*

* In one of these cases one patient remained twenty-three days because bleeding continued around the Penrose drains and there was an associated hyperpyrexia.

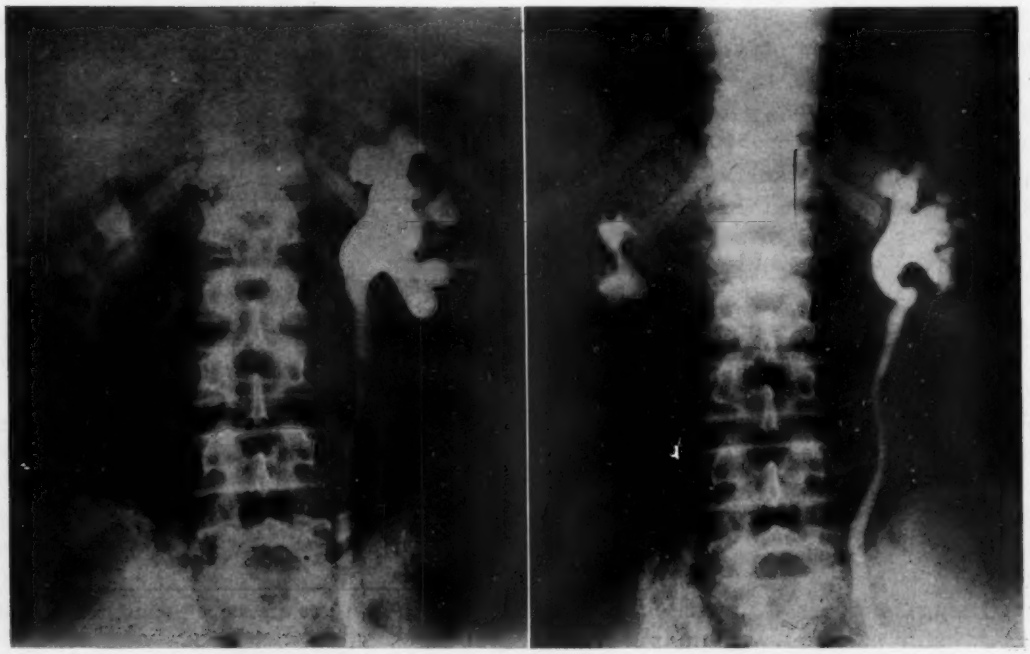
6A

urea nitrogen rose to a very high level and the patient died of uremia. (Table v.)

The Rovsing operation is beneficial in improving renal function in those cases in which there is an associated secondary renal pathologic disorder. At operation the complicating condition may be corrected. One patient had multiple renal calculi which were removed, and a Rovsing operation was performed. Another patient had perirenal abscess which was drained, and a Rovsing operation was performed. The latter patient prior to surgery had blood urea nitrogen of 44 mg. per cent; eight months after surgery the blood urea nitrogen was 10 mg. per cent. (Table VI.)

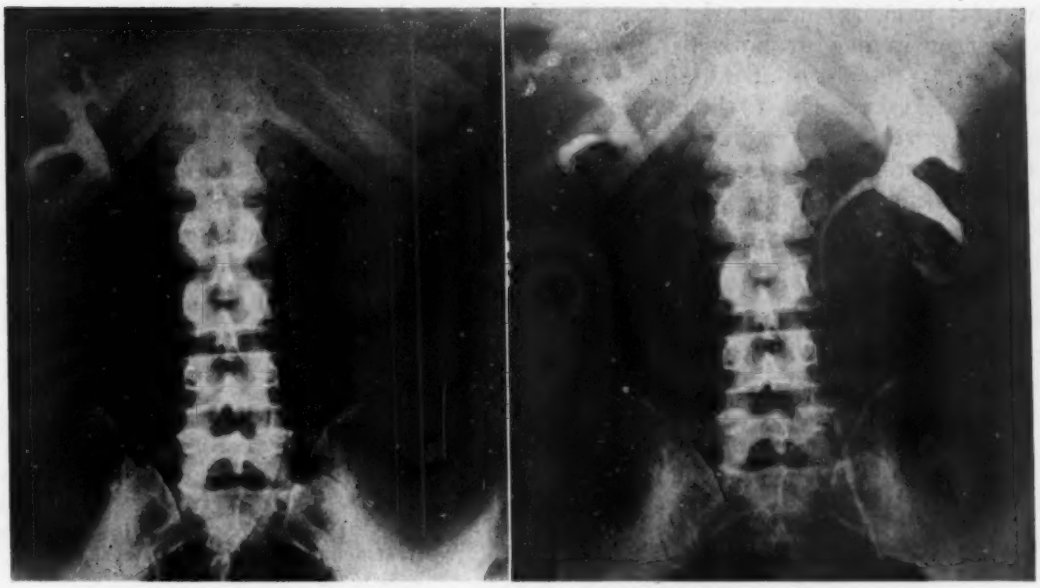
TABLE VI
CAUSES OF DEATH IN FIFTY-SEVEN CASES

Cause	No. of Patients
Uremia	13
Cardiac insufficiency	2
Pulmonary embolism	1
Cerebral hemorrhage	1
Neonatal death	1
General cachexia (carcinoma of breast with metastasis)	1



6B 6C

FIG. 6. A, right ureteropyelogram showing compression defect on middle major calyx suggestive of a cyst. B, left ureteropyelogram showing non-opaque calculus in the upper end of the ureter; the kidney is large, the pelvis large and dilated; the major and minor calyces are dilated and ballooned. At operation on the left kidney seven calculi were removed and Rovsing operation performed. C, left ureteropyelogram two years following surgery illustrates smaller kidney, major and minor calyces reduced in size.



7A 7B

FIG. 7. A, right ureteropyelogram showing large renal pelvis with elongated, dilated major calyces. B, left ureteropyelogram showing marked enlargement and elongation of the major calyces. C, bilateral ureteropyelograms three years following bilateral Rovsing operation for congenital polycystic kidneys.

Bilateral Rovsing operations were performed primarily for gross, uncontrollable hemorrhage. There was an interval of six weeks between the first and second operations. This patient's renal function on admission to the hospital was blood urea nitrogen 15 mg. per cent. Indigo carmine was excreted by the right kidney in six months in 2 plus concentration and by the left kidney in eight minutes in 2 plus concentration. This patient was followed for a period of three years postoperatively. The patient was asymptomatic; the result of the surgery was excellent. The renal function, however, at the end of three years was worse. The blood urea nitrogen was 18 mg. per cent. Indigo carmine was excreted by the right kidney in eighteen minutes in 1 plus concentration and by the left kidney in twenty-three minutes in 2 plus concentration.

Figures 7A and 7B illustrate ureteropyelograms preoperatively, and Figure 7C illustrates ureteropyelograms three years after surgery, in the same patient.

There is another group of patients upon whom a Rovsing operation was performed for unilateral, uncontrollable kidney hemorrhage. These patients responded well to surgery. They remained asymptomatic for many years. The renal function remained static or gradually decreased.

7C

SUMMARY AND CONCLUSIONS

Polycystic kidney disease occurs most commonly in the ages of forty to sixty; it may occur in the very young or in the old. Heredity plays an important part and several members of the same family are often afflicted. The most important symptoms and signs are as

follows: (1) pain, (2) hematuria, (3) palpable tumor either in one or both flanks, (4) albuminuria, (5) flat x-ray of the abdomen may reveal enlarged kidneys, (6) intravenous urogram may reveal poor excretion of dye by one or both kidneys; it also may show morphologic findings indicative of the disease, (7) retrograde pyelography is the most positive diagnostic method. There are two main types of urographic findings in polycystic kidney disease. The first type shows abnormality in the pelvis, often called the compression pelvis. These cases are often mistaken for renal tumors. It is often necessary to explore these surgically. The second type of deformity is one of bizarre dilatation, which is chiefly localized in the calyces, although the renal pelvis is sometimes included. (8) Renal function was greatly impaired in 75 per cent of the cases. Indigo carmine renal function test and phenolsulfonphthalein tests usually show decreased values. The total renal function was greatly impaired in 40 per cent of the cases, as shown by a marked elevation of the urea nitrogen in the blood. The retention tests of renal function usually give a better index of renal function than the excretory tests.

The treatment of the fifty-seven patients was carried out as follows: (1) Medical supportive treatment in thirty-four patients. (2) Surgical treatment in twenty-three cases; nephrectomy in seven cases; incision and drainage of cysts in ten cases; exploratory operation in six cases and drainage of perirenal abscess in one case.

When complications exist in one kidney which would indicate nephrectomy, one must determine whether the renal function of the other kidney is sufficient to sustain life. The type of surgical procedure carried out depends upon the renal status of each individual kidney.

The Rovsing operation is very beneficial in the alleviation of pain and the stopping of gross hematuria. The operation will not improve renal function *per se*. However, when an associated pathologic condition in such a kidney is corrected, the renal function will improve.

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TREATMENT OF PAPILLARY CARCINOMA OF THE THYROID WITH LATERAL CERVICAL METASTASES*

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PAPILLARY carcinomas of the thyroid commonly metastasize to the lateral cervical region, but unlike carcinoma elsewhere, metastasis does not imply a poor prognosis. In our experience the prognosis of those patients whose leading symptom is lateral cervical metastases has been considerably better than that of the patients whose leading symptom was primary tumor in the thyroid. This and other unusual features of the natural history of papillary carcinomas of the thyroid present a special problem.

There are several peculiarities of papillary carcinoma of the thyroid which explain the unusual behavior and prognostic features of these tumors.

1. Papillary tumors of the thyroid usually grow slowly and are of the lowest degree of malignancy. We have followed one patient's progress for over twenty-seven years during which time no treatment has been given. Yet the metastatic nodules, proved by biopsy, have not enlarged significantly.[1]

2. Even when the lateral cervical metastases enlarge steadily, they rarely become invasive or involve either the great vessels or the sternocleidomastoid muscle. The nodules, therefore, can be removed easily, either individually or in groups.

3. The metastatic nodules are true tumor emboli lodging in lymph nodes. Prolonged observation of a large group of patients after removal of individual nodes or groups of nodes has failed to reveal any tendency of the metastatic tumors to recur locally other than in lymph nodes outside the field of the original operation.

4. Prolonged observation of a small group of patients whose metastatic nodules in lymph nodes were overlooked at the time of removal of the primary tumor indicates that these metastatic nodules remain localized and grow slowly over a period of five to ten years. After the primary tumor is completely excised, no new metastatic nodules develop. Apparently the metastases do not tend to metastasize.[1]

5. The lateral cervical nodules usually can be removed as easily after many years of observation as when they are first recognized.[1]

6. Metastatic nodules in papillary carcinomas of the thyroid are not distributed through the usual channels followed by squamous cell carcinoma of the face or oral cavity, but through a system of deep lymphatics which bear metastases (1) to the deep nodes of the carotid sheath sometimes anterior to and usually behind the great vessels; (2) to the midline in the thyroglossal tract; (3) to the posterior triangles of the neck; (4) to the chain of lymph nodes behind the thyroid along the course of the recurrent laryngeal nerve; (5) below the thyroid, along the thyroidima vessels; (6) to the superior mediastinum and (7) to the axilla. Metastasis to the lungs is rare but may occur.

There is no operation which can remove in block continuity the entire lobe of the thyroid and all of the areas to which papillary tumors of the thyroid tend to metastasize. In view of the benign behavior of these tumors and the excellent results which have followed conservative operations designed to remove the involved groups of nodes,[1,2,3] I do not believe that radical and mutilating block dissections with removal of the sternocleidomastoid muscle are necessary or desirable. This is particularly true in young women in whom these tumors most frequently occur and to whom cosmetic results are of the greatest importance.

Papillary carcinoma of the thyroid can be treated as effectively with complete removal of the affected lobe or lobes and removal of the lateral cervical metastases in groups as by block dissection. In a series of eighteen consecutive cases with lateral cervical metastases in which I performed the first operation on the primary tumor in the thyroid, there have been no local recurrences of the thyroid

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tumor and no distant metastases. At the time of operation many of these patients had metastases in the superior mediastinum and one patient also had axillary metastases, yet all are living and free of demonstrable recurrence. Evaluating this experience and the fact that cosmetic results are so superior in the young women affected, the mutilation of block dissection not only appears to be unnecessary but also highly undesirable.

This condition was present predominantly in the younger age group; one-half were thirty years old or less.

Papillary carcinoma of the thyroid was suspected before operation in sixteen of eighteen cases and established during operation in the other two. In sixteen of eighteen the lateral cervical metastases were the leading symptoms. In two cases the primary tumor was the leading symptom.

The number of lateral cervical nodules varied from two to forty; the average was ten. Seven patients had more than fifteen separate metastatic nodules. There were five patients with bilateral distribution of primary tumors and metastases.

The duration of metastatic nodules before operation was one month to seventeen years, an average of over four years.

Nine patients had noted no enlargement and nine had noted progressive enlargement of the nodules. In all cases it was thought that the removal of the thyroid tumor was complete.

Several patients had received what was considered to be maximum therapeutic doses of roentgen ray before consulting us but despite this the nodules had persisted either unchanged or only slightly diminished in size. In no case was roentgen treatment given by us either before or after operation. In one case radon seeds were implanted at a point when the tumor was adherent to the trachea, despite the impression that the tumor was completely removed.

Duration of follow-up was six months to thirteen years, average five years plus. None of the patients died after operation (all eighteen patients are living and well). There was no distant metastasis. Also, there was no uncontrolled local recurrence or metastasis.

Five patients had cervical metastases removed by small secondary operations. The sites of these metastases were (1) contralateral (primary tumor involved isthmus) in one, (2) midline high in two and (3) overlooked nodes in lateral cervical region in two.

In the five patients upon whom secondary operations were performed, the recurrent nodules appeared within three years of the original operation and were removed by a small local operation. There has been no further recurrence from two to twelve years after the secondary operation. It is noteworthy that in only two of the eighteen cases did recurrence take place within the field of a block dissection.

TECHNIC

Local removal of the various groups of involved lymph nodes has resulted in the complete control of the tumor in all patients operated upon. In only one case, early in our experience, was a conventional block dissection of the neck performed with removal of the sternocleidomastoid muscle. This experience indicates that in cases in which the primary tumor of the thyroid is completely removed at the first attempt, the lateral cervical metastases are easily amenable to complete eradication by conservative procedures. In about half the cases, in all of which the nodules were confined to the lower neck, the entire operation was performed through a wide thyroidectomy incision. In the remainder, incisions along the anterior border of the sternocleidomastoid muscle were made, but the muscle was not removed. Occasionally the jugular vein was resected, as a matter of convenience, in patients having numerous metastases in the immediate vicinity of the vein. Because many of the nodes lie behind the carotid artery rather than anterior to it, resection of the vein does not often facilitate their removal.

For tumors which are confined to the lower neck, adequate exposure can be obtained through a wide thyroidectomy incision. Transverse division of the strap muscles facilitates exposure. The entire thyroid is carefully examined, both lobes being rotated from their beds and their posterior aspects inspected and palpated. The primary tumors may be only millimeters in diameter and can be overlooked. Twice we have reoperated upon patients who had been operated upon less than a year before and have found the primary tumor in the posterior part of the lobe in which it had been missed at the time of the first exploration. Occasionally the tumor is so small that it cannot be palpated and in these cases the entire

lobe should be removed. A primary tumor is invariably found by the pathologist.

When the lateral cervical metastases are bilateral, the entire thyroid must be removed. Separate primary tumors usually are found in both lobes or both are diffusely infiltrated with carcinoma. Parathyroids should be identified and preserved when possible.

The recurrent laryngeal nerve is often involved in the tumor or is at least adherent to it. The metastatic nodules below and behind the thyroid and in the superior mediastinum may seem to surround the nerve. Usually there is no direct invasion of the nerve, and the tumor and its metastases can be removed without damaging it. Occasionally, it is impossible to preserve the nerve without leaving tumor tissue; and when this is the case, the nerve should be sacrificed.

The metastatic nodules tend to occur in groups and are surrounded with adipose and areolar tissue which binds them together. Thus if one of a group of nodes is delivered into the wound, the others tend to follow in their envelope of fatty and areolar tissue. This tendency facilitates the delivery of mediastinal nodules which can be palpated through the cervical incision, the top one grasped and the others delivered by exerting traction on the first. In this way numerous mediastinal metastases can be removed through a simple thyroidectomy incision.

By similar technic axillary metastases can be removed by merely dissecting the thyroidectomy flap down over the clavicle, separating the fibers of the pectoral muscle and pulling out the axillary tumors in their fatty envelope from the apex of the axilla. The distribution of axillary metastases from carcinoma of the thyroid is the opposite of that of cancer of the breast; the apex of the axilla and the subpectoral nodes are involved first. The approach to these is easier through the pectoral muscles than from below.

When nodes are present in the posterior triangle or in the neighborhood of the brachial plexus, they can be removed by extending the thyroidectomy incision or by making a separate incision over them.

The midline should be searched carefully because there is a chain of nodes which extends upward from the thyroid along the pyramidal tract to the hyoid bone in which metastases are often found. The lowest of these, located just above the isthmus of the thyroid, is most often involved and has been named by Cope[4] the Delphian node.

CASE REPORT

The patient was a thirty-five year old woman who had noticed a nodule in the left supraclavicular area seven years before. Her family physician had reassured her and advised her to disregard it which she did for four years.

Three years before entering the hospital nodules appeared in the right side of the neck and in the left axilla. A year later a biopsy of the axilla showed a lymph node replaced by metastatic papillary adenocarcinoma originating in the thyroid. Biopsy of a node in the left cervical region showed the same type of tumor.

Twenty-one months before admission an attempt was made to perform a radical dissection of the nodes of the left side of the neck but was abandoned when it was found that they extended into the superior mediastinum.

During the next year the patient received an extensive course of roentgen therapy in fifty treatments given with supervoltage 500 kilovolt with a half value layer of 9 mm. of copper. A total irradiation of 5,200 r in air was given each side of the neck.

This was followed by only a slight regression in the size of the nodules. She was also given a tracer dose of I^{131}.

Examination revealed a young woman who appeared to be in excellent health. The right lobe contained a hard nodule 1 cm. in diameter. A hard nodule 2 cm. in diameter was palpable in the right supraclavicular region and many firm nodes were palpable beneath the left sternocleidomastoid muscle and in the posterior triangle on the left. A sense of fullness was also palpable under the pectoral muscles in the area of the apex of the axilla. X-ray of the chest showed no evidence of metastasis.

A tracer dose of 0.4 mc. of I^{131} was given and measurements indicated a take-up of 25 per cent in the thyroid area. On the following day, under intratracheal anesthesia, a wide thyroidectomy incision was made and the ribbon muscles were divided transversely. A hard nodule was palpable in the left lobe of the thyroid. A total thyroidectomy was performed and a chain of nodules on the left extending from the level of the hyoid to the clavicle was removed. Groups of nodes were excised from the anterior mediastinum on the left, from the right supraclavicular region, from the brachial plexus on

the left and from the apex of the left axilla. The latter was exposed by dissecting the skin flap down over the clavicle separating the pectoral muscles and withdrawing the nodes from the apex of the axilla.

Convalescence was uneventful except for development of mild and transitory tetany. Myxedema developed with a basal metabolic rate of minus 31 per cent and has been controlled by the administration of 2 gr. of desiccated thyroid daily.

Radioautographs of the removed lymph nodes showed a few pinpoint areas of I^{131}. Subsequent tracer studies, made when the patient was not taking desiccated thyroid, showed no concentration of I^{131}. Eighteen months after operation there was no palpable recurrence of tumor, and x-ray studies of the chest remain negative.

ROENTGEN AND RADON THERAPY

If complete removal of the thyroid tumor and its metastases is not possible because of invasion of vital structures, radon seeds may be implanted in the questionable areas.

We have not used roentgen therapy in any of the cases reported here, but in other cases in which the tumors recurred after operations performed elsewhere, we have seen no significant regressions after roentgen therapy given in as large doses as could be tolerated. In general, the papillary tumors are highly resistant to irradiation, and their supposed sensitivity is based on the fact that roentgen treatment has been credited with retarding the growth of tumors which were not growing rapidly to begin with. When untreated tumors require twenty-seven years to grow large enough to cause a visible lump in the neck, it is difficult to estimate what effects irradiation has had on their speed of growth.

RADIOACTIVE IODINE

Since radioactive iodine has become available, all suspected carcinomas of the thyroid are given a tracer dose of 0.5 mc. before operation. Following operation radioautographs are made of the tumors to determine whether or not they take up I^{131}. Two of nine papillary carcinomas have taken up significant amounts; but since in this group of cases we always have been able to eradicate the tumors and their metastases surgically, there has been no indication for I^{131}.

One patient, who had had a biopsy performed by another surgeon, had a palpable tumor of the thyroid, snowflake metastases in the lungs and a large metastatic node in the lateral cervical region. Both the tumor and its metastases took up I^{131} well and in response to 415 mc. given in eight doses over a period of nearly two years, the patient became myxedematous, there was no longer any take-up of I^{131} and the local recurrence and cervical metastasis disappeared. X-ray appearance of pulmonary metastases did not regress completely; since there is no longer any take-up of I^{131} in the lungs, the shadows may have been due largely to fibrosis around the tumor. The patient is taking desiccated thyroid, is working and entirely well seven years since his first operation and two years since treatment with I^{131}.

COMMENTS

There are two types of operation for cancer (1) operations on tumors in which the primary and its zone of lymphatic drainage are in continuity and are removed in a block, as in carcinoma of the breast, and (2) tumors in which the primary and its zone of lymphatic drainage are not in continuity, as in carcinoma of the lip. In the case of carcinoma of the lip the primary tumor is first removed, and later, if metastases develop, the regional lymph nodes are excised.

Papillary carcinoma of the thyroid is analogous to carcinoma of the lip in that it is not possible to remove in continuity the primary tumor, the lymphatics through which it spreads and the nodes which drain it. Consequently, one is justified in first removing the primary tumor, and then metastatic nodules if they become palpable. Performing a radical block dissection of the neck for a papillary carcinoma is much like resecting the mandible, the lower part of the face, the floor of the mouth and the nodes of the neck for an early carcinoma of the lip. Unquestionably, the operation would cure the cancer but so would local excision.

If papillary carcinoma of the thyroid occurred in old men, the cosmetic aspects of the operation would not be important, but four of five of these tumors occur in women, whose average age is only thirty. Many of these girls are unmarried and would be unwilling to accept the deformity associated with the conventional block dissection followed by intensive roentgen therapy if they were aware that

reported results of conservative operations on the lateral cervical metastases were as good or better than reported effects of block dissections and roentgen therapy.[1,5–7]

In papillary carcinoma of the thyroid emphasis should be placed on the treatment of the thyroid tumor rather than its metastases. The lateral cervical nodules can be dealt with easily if or when they appear. The important part of the operation is the thyroidectomy. If the primary tumor is not removed completely, it will recur locally and ultimately may invade vital structures, continue to metastasize to the neck, mediastinum or axilla, or even to the lungs.

In a recent article on carcinoma of the thyroid in which fifty-six cases were reported, the diagnosis of carcinoma was made only eight times before operation and in only nine more was the diagnosis suspected at the time of operation. In thirty-nine of these fifty-six cases (69 per cent) the operation was completed without the diagnosis of carcinoma being suspected.[8] Since the conventional thyroidectomy removes only the anterior portion of the lobe and since the posterior aspect of the lobe is a favorite site of papillary carcinoma, it is not surprising that there are a number of local recurrences of incompletely removed papillary carcinomas.

Many patients with recurrences following inadequate operations are referred to certain specialized institutions which limit their practice to the treatment of cancer, and in these institutions relatively few early or unsuspected carcinomas are encountered.[6] Hence it is understandable that the experiences of the staff of a hospital dealing almost exclusively with recurrences of inadequately treated papillary carcinomas are at sharp variance with those of a clinic in which the diagnosis of carcinoma of the thyroid is established or suspected before operation in over 90 per cent, and in which all operable patients are treated with complete lobectomy or thyroidectomy.[9] I believe that this difference in the type of case seen and in the initial treatment received by the patient explains the preference of cancer institutions for block dissection and the low rate of curability which they report.

It is possible that block dissection of the neck would be advantageous in selected cases of recurrent carcinoma scattered through the neck by implantations at the time of inadequate primary operations. Although this type of operation may be valuable in the treatment of recurrent cancer, it is not necessarily the proper treatment for the primary manifestations of the disease.

SUMMARY

1. Eighteen consecutive cases of papillary carcinoma of the thyroid with lateral cervical metastases are reported. Seven of the eighteen patients had more than fifteen metastatic nodules and one had forty. All patients are well and apparently free of recurrence from six months to thirteen years after operation, an average period of over five years.

2. The most important aspect of treatment is total removal of the primary tumor of the thyroid. The mutilating block dissection of the neck with removal of the sternomastoid muscle is neither necessary nor desirable. Removal of the lateral cervical metastases, individually or in groups through cosmetically planned incisions, gives as good a chance of cure as more radical operations.

3. Roentgen therapy is rarely necessary and when given is rarely effective.

4. Since most papillary carcinomas of the thyroid are curable by surgical excision, radioactive iodine has only a limited application in the treatment of this type.

5. A case of papillary carcinoma with pulmonary and cervical metastases which has regressed after treatment with radioactive iodine is reported.

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FRACTURES OF THE SPINE*

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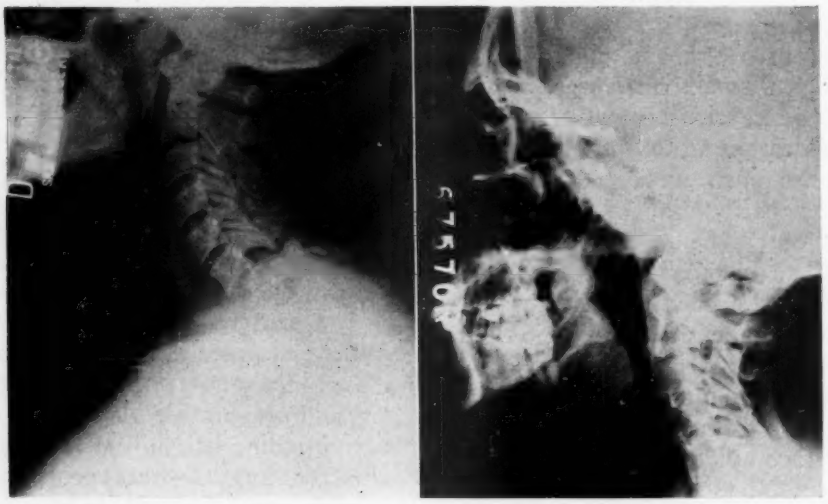
FRACTURES of the spine make up an important part of any orthopedic service; and although frequent reports in the literature may be found, most of them deal with treatment of the unusual type of fracture or fracture dislocation. Little time is devoted to the simple compression or comminuted fracture of the bodies or fractures of the transverse processes without neurologic complication. Methods of initial reduction are many and are discussed in detail, but after-care and rehabilitation are vaguely presented and the psychology of the patient is usually ignored. Of the various schools of thought along these lines, that of Watson-Jones is particularly appealing. It is the purpose of this paper to report the results achieved in the past five years at this hospital during which time the principles of Watson-Jones were rather rigidly adhered to. The series of cases is small and we do not have a similar series treated with another method for comparison. We have the impression, however, that our results are much better with the Watson-Jones method than previously and are certain that the incidence of traumatic neuroses in the compensation cases has been decidedly lowered.



1A 1B

FIG. 1. A and B illustrate a fracture dislocation of C6 on C7 with forward displacement of the body of C6; Crutchfield tongs were inserted and an open reduction with decompression and operative fusion was performed. Neurologic changes consisted of paresthesias in upper extremities and weakness of those muscles innervated by C6 and C7. Following reduction the paresis disappeared, but when last seen patient was still complaining of vague parenthesias of both arms.

A total of 146 spinal fractures were treated between January 1, 1945, and December 31, 1948. These included twenty-eight cervical, ten thoracic and 108 lumbar fractures. Space does not permit detailed analysis of these cases but the following conclusions appear to be permissible (Figs. 1 to 6):

Initial oblique x-rays are extremely important to detect pedicle and articular process fractures as hyperextension reductions may precipitate cord lesions in these cases.

If transverse myelitis is present in the absence of dislocation, reduction is performed and cast applied, windowed and spinal puncture performed. In the absence of block at the site

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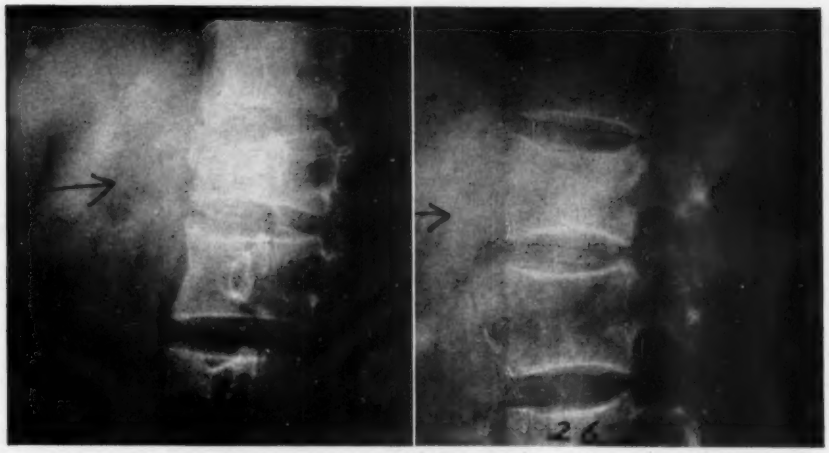
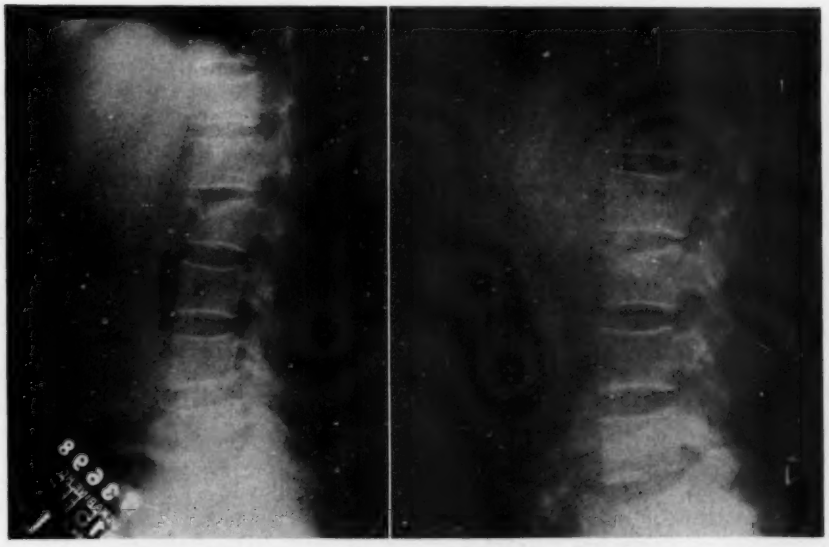


2A 2B

FIG. 2. A and B illustrate a compression fracture of the body of the first lumbar vertebra with the result four months later.



3A 3B

FIG. 3. A and B, comminuted fracture, body of the second lumbar vertebra; B shows union with correction of wedging.

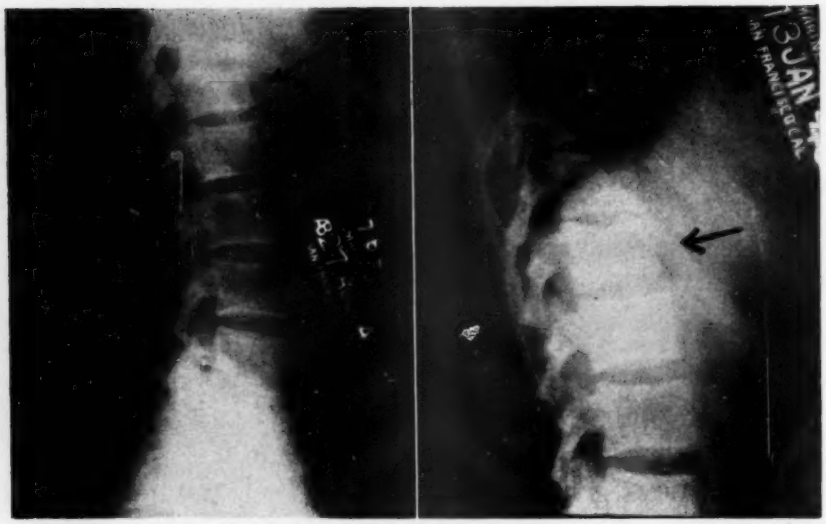
of the lesion, laminectomy does not influence recovery and, therefore, is not performed.

In the presence of dislocation reduction is performed with the cord exposed and is followed with operative fusion. Operative reduction of unilateral dislocation of the atlas on the axis is preferred to closed reduction.

In using the Watson-Jones technic of closed reduction of lumbodorsal fractures great care must be used to prevent hyperextension of the lumbosacral joint. Immobilization for four months with this joint in such a position will leave the patient with a disability that will exceed that of the fracture which is untreated.[2] After removal of the plaster, flexion exercises should replace the hyperextension exercises the patient has been practicing during this immobilization.

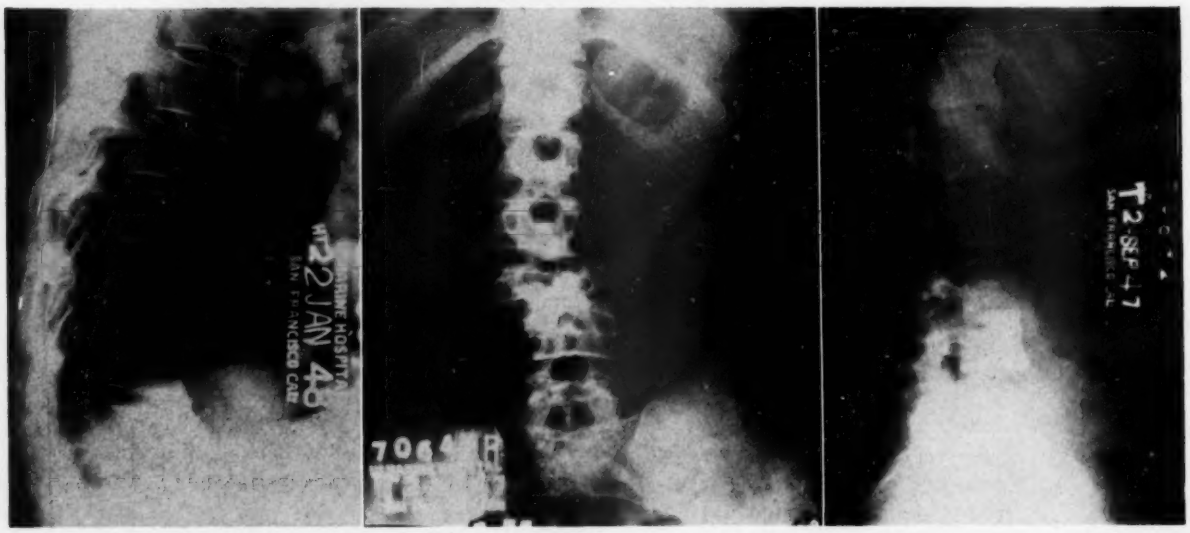
In comminuted fractures serious facet injury is attended by a high incidence of persistent pain and disability. Hyperextension immobilization often prevents the natural fixation and fusion which occurs in the untreated patient. We are at the present time immobilizing these cases in a neutral position without hyperextension and operatively fusing those which show no evidence of natural fixation after the first four months.

Multiple transverse process fractures should not be considered lightly. In our experience



4A 4B

FIG. 4. A and B, compression fracture, body of first lumbar vertebra; B reveals result on removal of cast after four months. There is no deossification in spite of long immobilization because of extensive exercise regimen.



5 6A 6B

FIG. 5. A neglected compression fracture of the body of the twelfth dorsal vertebra; fusion with D11 has occurred and patient is asymptomatic. Spontaneous fusion has not been observed where hyperextension immobilization was used, even when deformity was not corrected or recurred.

FIG. 6. A and B, fracture dislocation of third on the fourth lumbar vertebra; overriding of these two vertebrae is present. Neurologic changes consisted of a temporary paresthesia L3 and L4 only; the mildness of the neurologic change was due to the dislocation occurring around the cauda equina as an axis. Patient was received three weeks after injury with a large ulcer over the prominent spinous process in the lumbar area which further delayed surgery; lumbar spine was arthrodesed with no attempt at reduction.

they constitute a more serious problem than simple compression fractures. This is due to the extensive soft tissue damage and adhesion formation, and a high percentage remain with permanent disabilities that resist rehabilitation.

Avoidance of braces in any form is perhaps the single most important contribution of the Watson-Jones method of treatment of spinal fractures. After four months the fracture is as well healed as it will ever be; and if support is necessary, it should be in the form of operative fusion. Symptoms following removal of cast are due to adhesions which yield to exercises, not braces. The use of the brace during treat-

ment of the fracture is unsatisfactory as it is impossible to immobilize the patient adequately and he will rarely resist the temptation to remove it for a warm bath.

Finally, we believe that the cord bladder is best handled by urethral catheter for the first seventy-two hours, followed with manual expression until an automatic bladder is established. Liberal use of transurethral resection of the bladder neck is made to aid this process.

SUMMARY

The Watson-Jones technic of managing fractures of the spine provides uniformly good reductions and rehabilitation that provides dividends in an earlier return to work, a decrease in the incidence of traumatic neuroses and the reduction of treatment cost in each case.

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Boone et al. carried on a series of interesting experiments to determine whether or not the artificial production of pericardial adhesions might promote the development of collateral circulation of sufficient extent to be of clinical value in patients with myocardial ischemia. Their results were unsatisfactory because these newly formed blood vessels which appear a week or so after production of the adhesions do not persist and enlarge; instead, they disappear in about a month and are replaced by simple scar tissue. Other investigators have attempted to improve the circulation of the heart muscle in cases of coronary insufficiency by other methods. O'Shaughnessy attached the omentum to the myocardium via an opening in the diaphragm, whereas Beck transplanted part of the pectoralis muscle to the heart. All these methods have had some success but as yet surgery has not been able to improve greatly the condition of the average patient with myocardial ischemia and coronary disease. (*Richard A. Leonardo, M.D.*)

DETECTION OF UNSUSPECTED CERVICAL CANCER BY CELL STUDY*

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CANCER of the uterus continues to exact a mighty toll. More than 20,000 American women die of this disease each year.[1] Until we discover either the cause of cancer or a more effective method of treatment, our only hope of lowering the death rate of this disease lies in its diagnosis in the very early stages.[2] Careful clinical examination, the Schiller test,[3–5] the colposcope of Hinselmann[4] and routine microscopic examination[6,7] of every suspicious lesion have all played an important part in calling attention to malignant lesions of the cervix. But mortality rates still remain high. We realize today that a cervix which looks innocent to the eye of the examiner may harbor a silent cancer.[8] Biopsy of the suspicious lesions alone will not solve the problem. In very early cases we have no clinical way of identifying the cervices which are really suspicious. The infected cervix looks bad, but this is no indication that cancer is there. The healthy-looking cervix may be the guilty one. Today we do have a means by which the suspicious and malignant cases may be picked out. The selective cytology smear has been shown to be a most sensitive method in diagnosing malignant lesions of the cervix while they are still in the early, presymptomatic, curable stage.

We should like to present two cases of early cancer of the cervix, which would have been missed had routine cervical cytology smears not been taken and carefully examined.

CASE REPORTS

CASE 1. Mrs. A. B., white, widowed, forty-nine years of age, three pregnancies and one miscarriage, came to the gynecology outpatient clinic of the Royal Victoria Hospital complaining of itching about her vulva. Her past history was interesting in that she had her gallbladder (and appendix) removed because of cholecystitis with calculi seven years before. Three years ago she had a radical amputation of the left breast. The pathological diagnosis was "carcinoma solidum." She had been known to have diabetes since 1939, and this was controlled by dietary measures. On questioning it was found that she had some discharge along with the pruritus. Her last menstrual period occurred ten months ago. Since then she had but one bout of bleeding lasting about three days; this took place about six months ago. Examination revealed a reddened, irritated vulva. The cervix was the seat of a large symmetrical erosion which was equal on both lips. She was given symptomatic treatment for the pruritus, advised to attend medical clinic for a check on her diabetic condition and allowed to go home.

A routine cervical cytology smear (done on every new patient at this clinic) proved to be positive for cancer cells. The patient was asked to return to the laboratory. More cervical smears were taken. These confirmed the original impression. Many malignant cells were found in the smears. Accordingly, hospitalization was advised, and immediate admission followed. The next morning, in the operating room, with the patient anesthetized, a wedge of tissue was cut from the cervix, using a sharp scalpel. The pathological report was "chronic cervicitis." No cancer was found. (Figs. 1, 2 and 3.)

Examination under anesthesia revealed fibromyomas uteri, and it was believed that panhysterectomy, to be followed by serial sections of the cervix, was the procedure indicated in this case. Accordingly this was done. Multiple sections of the cervix were made, and microscopic examination revealed a small area of early, but unquestionable, squamous carcinoma.

The following features of this case were interesting: The patient had had cancer of the breast with no evidence of recurrence after three years. She now had cancer of the cervix.

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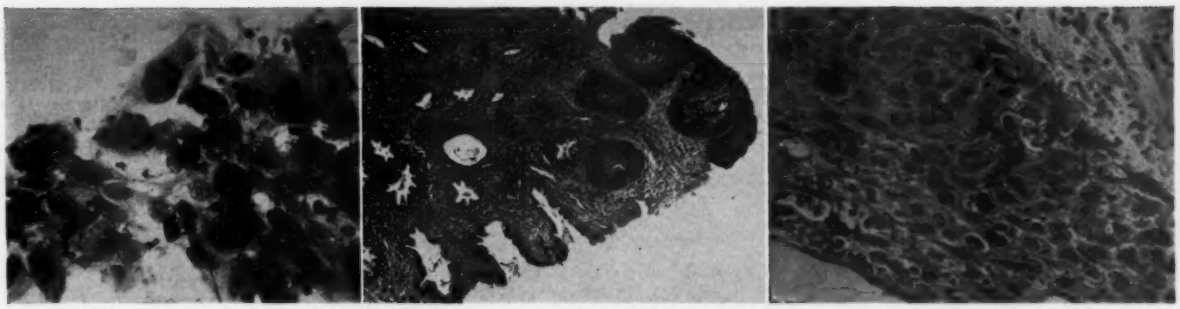
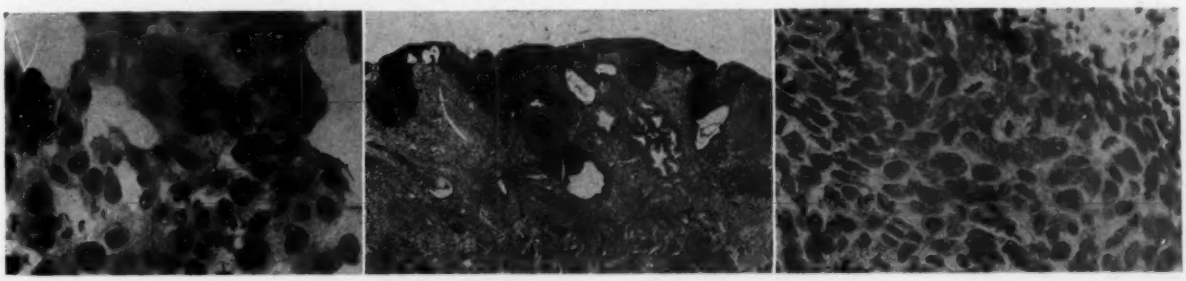


1 2 3

FIG. 1. Case 1, high power photomicrograph of a cluster of cancer cells from the cervix; some cells are multinucleated. Note the large hyperchromatic nuclei and the increase in the nucleocytoplasmic ratio; cells such as these were an indication of the true nature of the lesion.
FIG. 2. Case 1, low power photomicrograph of a representative section of the epithelium at the squamocolumnar junction of the cervix showing the malignant tissue invading the glands.
FIG. 3. Case 1, high power photomicrograph of Figure 2; note the large anaplastic malignant cells and the deep-staining mitotic figures; this patient complained only of vulvar pruritus.



4 5 6

FIG. 4. Case II, high power photomicrograph of the cervical cytology smear; note the cluster of malignant cells showing variation in the nuclear morphology.
FIG. 5. Case II, this is a high power photomicrograph of a representative area of the squamous epithelium of the diseased lip of the cervix of this patient; the other lip was normal; note the invasion of the glands.
FIG. 6. Case II, high power photomicrograph of Figure 5; the anaplastic cancer cells and the mitotic figures can be clearly seen. Comparison of the cells in this picture of the tissue with those in the cytology smear (Fig. 4) reveals their similarity; these are really the same cells obtained in different ways.

Her cervical cytology test showed a very high cornification count, indicative of an abnormally high estrogen level. Thiamine excretion tests showed that she was deficient in that part of the vitamin B complex. This case demonstrates the high estrogen, low thiamine, cancer complex seen in so many cervical malignancies.[9]

CASE II. Mrs. A. P., white, married, forty-four years old, with three living children, was admitted to the medical service of the Royal Victoria Hospital. Her complaints were right lower quadrant pain and headache. She had the pain for twelve years. Her menstrual periods were always accompanied with headaches. Functional inquiry revealed some frequency and nocturia. Her periods had been regular up until three months ago. Since then they have taken place every seventeen days, with each period lasting about four days. The family history is most interesting. The patient's mother and four aunts died of cancer. The patient herself had a morbid fear of cancer and was certain that she had malignant disease. The physical examination was essentially negative. The right kidney was slightly tender. The working diagnosis was right nephroptosis, menopausal syndrome and psychoneurosis.

A gynecologic consultation was obtained. The examiner found the cervix to be slightly eroded. A couple of nabothian cysts were noted, one on each lip. Otherwise, nothing abnormal was seen or suggested. Cervical cytology smears were requested as a matter of routine examination. These were positive and were reported as showing large numbers of malignant cells. Careful investigation was advised. (Figs. 4, 5 and 6.)

The patient was taken to the operating room, anesthetized, and in the absence of any suspicious visual lesion, sections were taken from

the anterior and posterior lips of the cervix. Then a curettage of the fundus was done. The biopsy report confirmed the cytologic picture. The cervix was proven to be the seat of a malignant lesion. The cancer was squamous in nature, early, but rapidly growing. The interesting and important finding in this case is that only one lip of the cervix was cancerous. The other lip was normal. To visual examination there was nothing that might suggest that one lip was more likely to have cancer than the other. Had the usual single section for biopsy been taken, there was a 50 per cent chance that this cancer would have been missed.

Beyond doubt these two cases established several facts of vital importance to every practising physician. Very early, asymptomatic cancer of the cervix defies clinical diagnosis.[8,10] In each of our cases the gross appearance of the cervix was in no way suggestive of malignancy. The first woman had pruritus associated with diabetes. The second had a morbid fear of cancer. Both of these complaints are common enough. By our present standards any physician would have been justified in treating the diabetes and pruritus in the first case and in providing reassurance for the second patient. Fortunately for these two women, routine cervical cytology smears were taken. The positive reports led to thorough investigation. Instead of going home to await the inevitable hemorrhage which heralds advanced clinical cancer of the cervix, these women have had an early lesion located and treated and have every chance of being permanently cured. Clinical symptomatic cancer of the cervix is advanced cancer. These cases are examples of early presymptomatic lesions. Clinical examination failed. Not only were the lesions not diagnosed, but also the appearance of the cervix did not lead the observers even to suspect that cancer might be present.

That microscopic examination of tissue is practically infallible is an undisputed truth.[11] If the tissue under the lens is malignant, a good pathologist will, in the great majority of cases, recognize it as such.[12,13] The failures occur because of the method of sampling. Physicians send bits of tissue to the pathologic laboratory every day to make certain that no cancer is present. In most cases the report is negative, treatment is given and no more is heard of the case. A few women, however, may eventually return to the doctor, bleeding and terrified, with clinical cancer of the cervix. Says the clinician, "I can't understand it. The biopsy was negative." Retorts the pathologist, "The sections which we examined showed no cancer. It is not our fault if the tissue was taken from the wrong area." No one is to blame, but the patient dies of cancer. It is obvious that if the tissue for biopsy is taken from a normal, non-cancerous region, the pathologist cannot be expected to find cancer. The responsibility lies with the clinician. He must cut his section from the diseased area.

Each of our cases is illustrative of this situation. In the first case the original biopsy was negative, and under ordinary circumstances the patient would have been discharged from the hospital with a clean bill of health. In the second case, because of the positive cytology, not the usual single biopsy was done, but tissue was taken from both lips of the cervix. Only one section showed cancer.

To be really satisfactory for biopsy tissue from the cervix should fulfill certain requirements, namely, (1) It must be taken through the squamocolumnar junction, for this is the focal point at which most carcinomas of the cervix have their origin. (2) It should include some normal tissue so that comparison may be made. (3) It must be cut through the malignant lesion. The pathologist cannot diagnose cancer by looking at normal tissue.

Let us review briefly some of the common ways that tissue is obtained from the cervix for biopsy examination.

The instrument which is most widely used and is pictured in textbooks is the Burnam biopsy forceps or "biopsy punch." This is a neat little instrument which is fairly easy to use; no anesthesia is required; it can be used as part of an office procedure and it is, therefore, used by many practitioners who are interested in the detection of cancer. In its place, and when it is used properly, the biopsy punch is a valuable addition to the armamentarium of the doctor's office, especially for confirmation of a clinical lesion. However, the common practice of biting a single tiny specimen from an area chosen at random can, in preclinical lesions, only serve to lead both doctor and patient into a state of false security. Unless used by one who is expert in its use, it does not provide us with a good section

through the squamocolumnar junction. It does not always get some normal tissue along with the diseased. It does often miss the lesion entirely. All in all it gives the pathologist a rather poor specimen of tissue for study. Yet many men make vital diagnostic and therapeutic decisions on the basis of a bit of tissue obtained by this method.

Many doctors, realizing the dangers and false conclusions to which one is led by the use of the biopsy punch, bring their patients into the hospital and obtain the tissue for examination using a sharp scalpel (with the patient anesthetized). This method is far superior to the punch biopsy. It does provide us with a good section through the squamocolumnar junction. It does give us some normal tissue for comparison. However, we can never be certain that we are taking the section through the right area. In the early cases, before ulceration has taken place, the surgeon is hard put to decide from just what region he will cut the section. Both of our cases show clearly how this method of obtaining tissue for biopsy can mislead us. In the first case the original biopsy report was negative. In the second, only one lip of the cervix had undergone malignant change. The usual single section might have missed this for there was no overt lesion to suggest the location of the diseased area.

Since the single surgical section is not sufficient to rule out cancer of the cervix, it has been suggested that multiple sections[26] might be the answer to the problem. Undoubtedly, as the single surgical section is better than the punch biopsy, so multiple sections constitute a quantitative improvement. However, a question of practicality comes up. Are we to bring every woman into the hospital and do multiple sections of her cervix to see whether she has cancer? This is certainly not a practical thing to do. Are we to do this only in suspicious cases? But which cases are the suspicious ones? We have seen that very early cancer of the cervix gives no clinical hint as to its presence, and it is, after all, the early cases for which we are seeking.

Any woman may have cancer of the cervix, the absence of abnormal bleeding or ulceration notwithstanding. Hence we must carefully check every woman, not only the ones with so-called "suspicious" symptoms or "suspicious" cervices.

If we are to lower the mortality rate of cancer of the cervix, we must have an easy diagnostic test which can be given to every woman regardless of the appearance of her cervix. Our two examples are cases in point. We must stress that the selective cervical cytology smears were taken on these women as part of a routine and not because of any suspicious lesion of the cervix. We believe that the selective cervical cytology smear is the test which we need in our efforts to find early curable cancer of the cervix. The test is an easy office procedure[14] which causes no discomfort to the patient. It is based on sound principles and is an accurate indicator of the presence of malignancies of the uterus. It obtains representative cells for examination from every part of the cervix and fundus, not from a localized spot. It is true that specialized training is required before one can interpret these smears, but we have a way of preserving the smears and sending them to a central laboratory in which expert staining and study can be carried on. Thus the practitioner, who may be inexperienced in this field, is relieved from the responsibility of interpretation.

The basic principles of this diagnostic method are easy to understand.[15,16] Most of the tissue of the female generative tract is derived from the müllerian duct epithelium and hence has the property of desquamation. Thus the tubes, endometrium, cervix and vagina are continually throwing off cells that gradually pass downwards. Malignant tissue is more friable and desquamates much more freely than does normal tissue. Hence, when there is a malignant lesion of the uterus, the cancer cells should be identifiable in the secretion. That this is the case was first shown and proven by Papanicolaou in his studies of vaginal smears. Work by Ayre[17] in Montreal, Meigs in Boston[18,19] and Isbell in Boston[20] has confirmed Papanicolaou's finding.

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squamocolumnar junction with a wooden spatula.[17] The smears are never allowed to dry. They are immediately placed in a mixture of equal parts ether and 95 per cent alcohol. These are then stained using a special method, mounted and studied under the microscope.

We believe that the cervical smears are superior to the older vaginal method.[17,21] It is true that the taking of the cervical smears is a little more complicated in that it necessitates the use of a speculum. However, the cervical method offers the following advantages: (1) The cervix is visualized each time the smear is taken. (2) The vaginal smear method takes the cells from the posterior fornix where they are mixed with and obscured by the vaginal debris. The selective cervical method gets the cells directly from the cervix. (3) In the cervical smear the malignant cells appear in groups and are fairly easy to locate, while in the vaginal smear the cancer cells appear singly, mixed and diluted as they are by the vaginal secretions, and are therefore harder to identify. (4) Since most genital malignancies are cervical, it seems logical to take the smears from an area as close as possible to the site of the lesion.

The simplicity of taking the smears is truly remarkable. Within a few months a technician can learn to take the smears properly. Since most of the gynecology in this country is being done by the general practitioner, we must, if we ever hope to conquer cancer of the cervix, offer a test that is as easy to carry out as the Wassermann test for syphilis. Once the doctor has taken the blood and sent it to the laboratory, his job is done. In the same way, once the physician has taken the smears and sent the slides to the cytology laboratory, he has done his duty. The actual staining and mounting of the slides may be of interest to the practitioner, but is of no practical importance to him. The interpretation of the slides can be done only by an expert cytologist. Ayre and Dakin[22] have described a technic which makes it possible to mail slides without the cells undergoing any deterioration. After the slide has been fixed in the ether 95 per cent alcohol solution for an hour, a large drop of glycerine is placed on the smear. This is covered by a clean glass slide, placed in a cardboard slide container and sent off in the mail.

The cervical cytology test presents many advantages, namely, (1) It is a simple and painless "office test."[23] (2) It is rapid, being taken, stained and read in a morning.[24] (3) It is inexpensive. (4) It can be repeated as often as necessary without harm to the patient. This is of great value in follow-ups. (5) No hospitalization is required. (6) It permits diagnosis in relatively early cases, even before the appearance of clinical symptoms. (7) It is of tremendous value in screening large numbers of patients. (8) It is reliable and accurate in the hands of experienced men. This has been proven many times by Papanicolaou, Ayre and Meigs. (9) It does not conflict with the established methods of diagnosis. On the contrary, it is a valuable complement to them.

The disadvantages, too, must be considered. They are the following: (1) Specialized training is required in order that accurate interpretation may be carried out. (2) It does not show the grade of malignancy, although it may occasionally give some hint as to the prognosis. (3) It does not supply information as to the mitotic activity of the malignant cell or its relationship to the adjoining tissue. (4) The type and origin of the malignant cell are not always clear.

No diagnostic test is infallible. The cervical cytology smear is no exception. It has a real and important place in medical practice, but it is not a gynecologic panacea; it is not a magic test. The great value of this cancer-detecting aid is reached in certain types of cases. In others it is of value but does not reach the same level of importance. For example, a seventy-five year old woman comes to her doctor and tells him, "Doctor, I passed my menopause twenty years ago. I have had no bleeding until a couple of months ago when I noticed a few spots on my underwear. The day before yesterday I lost a cup of blood." The procedure of choice is obvious here. This is not the type of case in which the cytologic diagnosis plays its greatest role. Or, a forty-five year old married woman comes to her doctor with the following story: "About eight months ago I began to notice a watery discharge which has a bad smell. Sometimes after I have connection with my husband I have a little bleeding from the front passage. I have lost 15 pounds in the last three months." Examination reveals an ulcerated, necrotic, bleeding cervix. The diagnosis is obvious. Cell study helps but is of no prime importance. Biopsy of an excised portion of such a lesion

is necessary but only for confirmation of an obvious malignant lesion. The patients of whose type we have just given two examples have symptoms which point to the type and location of the lesion. The man who complains of weight loss, fatigue, night sweats, weakness, cough, excessive sputum and hemoptysis, and in whose chest bubbly rales are heard, probably has tuberculosis. In such a case radiologic examination is of great importance but is not the means of diagnosis of early curable tuberculosis. On the other hand, when routine chest plates reveal an early unsuspected lesion in a supposedly healthy individual, then the chest x-ray has performed a task of immeasurable importance. This early lesion can be cleared up. It is the same with cervical carcinoma. Diagnosis of advanced clinical cancer is no great achievement. This can be done without the cytology test. In what type of case then does the selective cytology smear play such an important role? We refer to the woman who is in apparent good gynecologic health, with no abnormal bleeding, no blood-tinged, foul-smelling discharge, no pelvic pain, in short with none of the symptoms which would lead to suspicion of a malignancy. Our cases are good examples in point. We know that very early cancer of the cervix is without symptoms. It is in these early, preclinical, curable cases that the selective cervical smear plays its all-important part. For, if a cervix which is causing no symptoms and which appears healthy to clinical examination is harboring an early carcinoma, the selective cytology smear will, in the great majority of instances, point it out while the lesion is still in a curable stage.

What can the practising physician expect from the cytologist? How are the results of the test reported? From a consideration of the patient's age and history combined with the results of the cytology test, the cytologist will make one of several recommendations. (1) Negative for cancer cells: These patients should have a periodic check. (2) Suspicious: In these cases the cytology test should be repeated in one or two months, whatever the individual case may indicate. Or, even an immediate repeat test may be requested. (3) Positive for cancer cells: These are the patients who must be completely investigated until the cancer is found.

The cytologist has not taken over the job of prescribing treatment. The function of the cytology test is to pick out the positive cases and call attention to them. The rest is up to the clinician and the pathologist.

Those who have had much experience with the cervical cytology test are so convinced of its value and its accuracy that they will omit no diagnostic technic in an honest effort to find the site of the lesion when a positive smear indicates that cancer is present.[25] The reported cases are striking examples. Should the first biopsy report be negative, the next step, we believe, is amputation or conization of the cervix. Some men might prefer a total hysterectomy in such cases. This must be followed by multiple or serial sections, and the cancer will be found. Novak,[2] Martzloff[4,6] and Te Linde[8] all advise conization or amputation of the cervix and serial sections in every case in which there is clinical suspicion. Surely these procedures are indicated when suspicion is founded on a test as accurate as the selective cervical cytology smear.

There are some who say that amputation of the cervix is not practical because it requires hospitalization. We warn our students that every woman with abnormal bleeding should have a curettage to rule out cancer of the fundus. Yet cancer of the fundus is much less common and much less malignant than is carcinoma of the cervix.

What of the 1 or 2 per cent of the patients in whom the cytology smear reports a false positive; in whom serial sections are negative? What harm has been done? No harm, but a great deal of good has been done. In the first place we may then be certain that there is no cancer of the cervix; secondly, as is so often the case, if there is some chronic infection, there is no more effective treatment than conization.

Teamwork and close cooperation is mandatory if we are to attain any success in our efforts toward the diagnosis of early curable cancer of the cervix. The practitioner has the most difficult task. He must convince his patients that periodic examinations are essential. Once a hemorrhage has taken place it is too late. He must check his female patients at least once a year. A cervical cytology smear is taken each visit. The cytologist sorts the wheat from the chaff. He picks out the suspicious and the positive cases. The task of the gynecologist or surgeon is to obtain the tissue

for biopsy. The pathologist has the final responsibility of examining the tissue and determining the site of the malignant lesion. A positive smear means that cancer exists somewhere. Only by the closest cooperation can such cases be carried to a hopeful and successful end.

SUMMARY

1. Two cases of early carcinoma of the cervix, which were diagnosed by routine selective cervical cytology smears, are presented.

2. Clinical judgment is not sufficient grounds upon which cancer of the cervix can be ruled out. The most innocent-appearing cervix may be the seat of a silent, but active, cancer.

3. The pathologist can report only what he sees. Unless the tissue sent to the laboratory contains the cancer, the pathologist cannot be expected to make the diagnosis.

4. In preclinical lesions the common practice, on the part of men unskilled in intravaginal manipulations, of using the biopsy punch to obtain a single tiny bit of tissue provides an inferior specimen and leads to false impressions.

5. The single surgical specimen is better, but a single bit of tissue may miss the lesion.

6. Multiple biopsy specimen method is still better, but this is not a practical procedure. We cannot expect the practitioner to admit to the hospital every one of his female patients to have this procedure carried out. Yet how is one to pick out the suspicious cases? The selective cervical cytology test performs this function.

7. The basic principles of the cytology test and the various methods of taking the smears are briefly described.

8. Reasons are given for our belief that the cervical modification of the test is superior to the original vaginal smear technic.

9. The advantages of the cervical cytology test as a routine procedure are listed.

10. A case with positive cytology deserves a complete investigation including, if necessary, cervical amputation followed by serial sectioning as well as curettage of the fundus.

11. Stress is laid on the importance of cooperation and teamwork among the various members of the profession if we are to achieve the goal of finding cancer of the cervix in an early curable stage.

CONCLUSIONS

In the face of our present incomplete knowledge of the etiology of cancer of the cervix and our available methods of treatment, the only hope of lowering the death rate from this disease lies in its diagnosis when the lesion is at an early, asymptomatic, preclinical, curable stage. In order to achieve this goal we must provide the practitioner with a test which is as simple to carry out and as efficient a diagnostic method as the blood test for syphilis. When cancer of the cervix is still in its early curable stage, the woman is to all intents and purposes a well person. We must, therefore, strive toward the ideal state of periodic examinations of healthy women. A cervix which is normal to clinical examination may be the seat of a silent cancer. The selective cervical cytology test has been proven capable of diagnosing cancer of the cervix in its presymptomatic, pre-ulcerative state. Therefore, every well woman should have periodic cervical cytology smears taken. The test is so accurate that women with positive smears should be immediately hospitalized and fully investigated until the lesion has been found and treated, at a stage when treatment can still be successful. When this routine is followed by every practitioner, we shall see an increase in the number of early diagnoses and a concomitant fall in the mortality rate.

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GASTRIC LEIOMYOMA

WITH SPECIAL REFERENCE TO INVOLVEMENT OF THE PARAESOPHAGEAL FUNDUS

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THAT benign gastric tumors are no rarity is shown by more than 1,500 reports in the surgical literature. The most common form is the adenomatous polyp of which there were eighty examples in 176 reports from the Mayo Clinic.[2] In this category a group of forty-four tumors consisted of leiomyomas, fibromyomas, adenomyomas and myxofibromas —variants of the class of smooth muscle tumors. Several authors maintain that leiomyomas are the most common variety of benign gastric neoplasm. Collins and Collins found an incidence of 39.9 per cent in a group of 1,347 benign gastric tumors studied in the literature. Rieniets also stressed the high incidence of leiomyoma in routine autopsies.

A cursory review of the literature during the past twenty-eight years showed fifty-seven examples of leiomyomas, and of this number twenty-nine were reported in the past ten years.

Pathology. Leiomyomas vary in size from small peas to cantaloupes, but usually average between 2 and 3 cm. in diameter. They are rarely palpable (eight of fifty-seven cases of our collected series, 14 per cent) and usually take origin in the mucosa or submucosa. At times they may have narrow pedicles (25 per cent) or attachments to the stomach by broad bases. The majority (approximately 72 per cent) lie within the lumen of the stomach but occasionally occupy an almost completely extragastric position (two of twenty-three cases[2]). From our own analysis of fifty-seven cases, fifteen (26 per cent) were extragastric. The usual site of the tumor is the middle third of the stomach at the pylorus, on the anterior or posterior wall and away from the curvatures. In Eusterman's series there was only one tumor at the cardiac end of the stomach. Our analysis shows approximately thirteen. Portis maintains that only 10 to 12 per cent of the tumors are in the upper third of the stomach. Leiomyoma, commonly single, may be present multiply connected. As a rule they are ovoid and present smooth, slightly lobulated surfaces. Of a group of twenty-three tumors in the category in question (reported from the Mayo Clinic by Eusterman and Balfour) twenty were single. When the tumor involves the gastric lumen, the surface thereof becomes ulcerated (47 per cent) and bleeds (26 per cent[2]). Unlike ulcers and carcinomas which are discovered predominantly among men, this variety of tumor shows no sex predilection (in our series the incidence for women was 49 per cent and for men, 51 per cent).

Leiomyomas may occur as pure muscle tumors or as mixed forms—fibromyoma, adenomyoma or myxofibroma, for example. Free hydrochloric acid is rarely absent from the gastric contents (about 8 per cent[2]).

While malignant degeneration of the tumors is a distinct possibility, none in the Eusterman series underwent malignant changes.

Symptoms. Unlike malignant tumors of the stomach, leiomyoma, because it rarely interferes with the motor or secretory gastric function, is usually asymptomatic unless situated in close proximity to the pylorus or cardia where it commonly causes obstruction. When symptoms occur they are usually caused by complications, such as anemia owing to gross hematemesis, with or without melena (our series—hematemesis 30 per cent, melena 40 per cent), intermittent pyloric obstruction, malignant degeneration or intussusception.

Bleeding is probably the most frequent and significant symptom of gastric leiomyoma and often results in notable anemia. The incidence of severe hemorrhage from an ulcerated tumor far exceeds that seen in pyloric ulcer or malignant tumors. Although macrocytic anemia may occasionally be discovered, the usual form is secondary anemia of the microcytic variety. Gastrointestinal bleeding with its associated severe anemia may be the only symptom. In fact, any patient with a severe grade of secondary anemia which cannot be accounted for by the usual routine examinations should

undergo a careful examination of the stomach to rule out an ulcerating leiomyoma.

Symptoms closely simulating duodenal ulcer may be complained of by patients suffering from tumors situated in close proximity to the pylorus. If the tumor is in juxtaposition to the cardia, the symptoms may be suggestive of esophageal obstruction. In our series in 20 per cent of the patients the tumor was revealed at or near the cardiac end of the stomach.

A presurgical diagnosis of intussusception resulting from leiomyoma of the gastric wall is usually impossible despite severe pain and prostration which are invariably mistaken for biliary colic or a perforated duodenal ulcer. The incidence of pyloric obstruction resulting from this kind of tumor, according to Portis, is approximately 15 per cent.

Diagnosis. While in the last analysis the diagnosis of leiomyoma can be made only by histologic study of the tumor itself, there are several features concerning this group of neoplasms which may at least suggest the probability of the benign character of the lesion. Many examples of this variety have been found in young patients in contradistinction to carcinoma. In addition, the relative rarity of digestive symptoms, despite the high incidence of gastric hemorrhage, is of prime significance. Palpation of a large, epigastric mass in an anemic patient with few if any digestive symptoms is clearly suggestive of a non-malignant gastric tumor.

Roentgenography occasionally indicates the benign character of the tumor. There is a clearly circumscribed filling defect centrally situated in the stomach which fails to distort the gastric rugae or to interfere with normal peristalsis, as noted on fluoroscopy. Gastroscopy may suggest a diagnosis if the tumor is situated in an accessible part of the stomach. The submucosal site of the tumor is assumed owing to the stretching of one or more mucosal folds circumjacent to the growth and up to the surface of the growth (Schindler, Sandweiss and Mintz).

Treatment. The treatment of leiomyoma of the stomach is surgical, even for patients with no urgent symptoms, because there is a possibility of exsanguinating hemorrhage and inability to exclude the presence of malignant degeneration or the possibility of subsequent malignant change in the tumor.

There is little excuse for refusing surgical treatment regardless of the size and site of the tumor in question, especially in the absence of obvious metastases. The nature of the surgical treatment depends upon the site of the tumor, the degree of hyperacidity and the certainty that the tumor is not malignant.

In lesions of the fundus or antrum, in the absence of hyperacidity, the tumor-bearing part should be resected and intestinal continuity reestablished by any of the accepted methods. When there is high acidity, resection should include the acid-bearing part of the stomach, as is customary in operations for duodenal ulcer. Transthoracic gastrectomy with esophagogastrostomy is carried out solely for patients with tumors in or around the uppermost part of the stomach and cardia. There were two patients in our series who underwent transthoracic subtotal gastrectomy.

CASE REPORT

Mr. L. P. R., aged seventy, retired insurance broker, consulted us on September 1, 1949, stating that four months previously he passed several large tarry stools over a period of two weeks. Since then he felt extremely weak. Family and past history were non-informative. He used tobacco moderately and for the past ten years had abstained from alcohol. He denied having lues but stated that he had gonorrhea many years previously.

For several years he suffered mild episodes of postprandial, upper abdominal distention. His appetite was always good and his bowels regular. Although feeling weak following an attack of melena four months previously, there was no loss of weight. He had been under treatment for what was assumed to be coronary sclerosis.

Gastric roentgenograms disclosed a large filling defect in the paraesophageal part of the greater curvature of the fundus and on gastroscopy nodulations were noted in the region of the cardia. (Figs. 1 and 2.) Esophagoscopy showed no abnormalities and specimens taken for biopsy were reported negative for carcinoma. Roentgenograms of the chest showed no metastases.

Physical examination was essentially negative.

Blood count: hemoglobin 92 per cent, red blood count 4,600,000, white blood count 8,900, color index 1.0, 64 per cent polymorphonuclears, 30 per cent lymphocytes, 2 per cent monocytes, 3 per cent eosinophiles and 1 per

1 2

FIG. 1. Roentgenogram of stomach showing large niche in paraesophageal portion of fundus.
FIG. 2. Roentgenogram of stomach showing large filling defect in cardiac region of stomach.

cent basophiles. Sedimentation rate was 10 mm. in one hour.

Gastric Analysis:	Free HCl	Total Acidity	Blood
Fasting specimen.....	0	45	4 plus
1st specimen after alcohol...	45	52	4 plus
2nd specimen after alcohol...	84	123	4 plus

Presurgical diagnosis was carcinoma of paraesophageal region of gastric fundus.

At operation (September 27, 1949, by J. A. L.) a transthoracic resection of the cardiac half of the stomach and esophagosgastrostomy for tumor of the paraesophageal part of the fundus were done.

Under intratracheal anesthesia of gas-oxygen-ether, the left hemithorax was entered through a long incision over the ninth rib with complete removal of the rib. After dividing the pulmonary ligament between clamps, the lung was retracted upward; the lower end of the esophagus was mobilized after dividing the mediastinal pleura. The vagi were sectioned. The left phrenic nerve was crushed and the diaphragm opened through a long radial incision extending from the costal arch through the esophageal hiatus. Upon entering the peritoneal cavity the stomach presented a large, smoothly lobulated tumor about the size of a small grapefruit arising from the paraesophageal part of the fundus and extending into the peritoneal cavity. The tumor did not apparently invade the esophagus. No metastatic foci were found. (Fig. 3.)

The lesser peritoneal cavity was entered by dividing the gastrocolic ligament near the upper end of the greater curvature. Owing to the somewhat enlarged spleen, a splenectomy was performed which gave ample room for the subsequent maneuvers. After dividing the left gastric artery near its origin and the gastrocolic omentum between clamps, the stomach was fully mobilized, a DePetz clamp applied and the organ transected at the junction of the middle and lower thirds. The distal end was reenforced with two layers of chromic catgut, followed by a layer of silk Lembert sutures. The proximal cut end of the stomach, grasped with a crushing clamp and covered with an iodoform pack, was easily lifted into the left pleural cavity. The distal pouch of the stomach was then readily elevated into the pleural cavity and a customary esophagogastrostomy was accomplished. The lower 3 inches of the esophagus was connected to the upper anterior wall of the gastric pouch, using a layer of interrupted sutures of silk to approximate the posterior wall of the esophagus to the anterior wall of the stomach.

Following the insertion of this row of sutures, the posterior wall of the esophagus was incised

transversely and a similar incision was made in the adjacent anterior wall of the stomach. A second posterior row of interrupted chromic sutures was then introduced, after which the tumor and the lower 3 inches of esophagus were completely transected and the specimen removed. The anterior wall was closed with a layer of interrupted chromic sutures applied so that the knots were placed intraluminally. This was followed by a row of interrupted Halstead sutures of silk.

Before closing the anastomosis, a Levin tube which had previously been placed in the esophagus, was passed into the stomach. The stomach was attached to the mediastinal pleura with interrupted silk sutures and the diaphragm to the stomach with a similar row of sutures.

The diaphragm was closed with two layers of interrupted silk sutures. During the procedure the lung was inflated at thirty-minute intervals. The wound was closed in layers after introducing a solution of penicillin into the pleural and peritoneal cavities. A No. 22 Foley catheter was placed into the pleural cavity for underwater drainage.

During the operation 1,500 cc. of citrated blood were administered.

Ambulation was begun in twenty-four hours. Liquid feedings were started through the Levin tube after a day. Foley catheter was removed on the fifth day, and following an uneventful convalescence, the patient was discharged from the hospital on October 19th, with wound healed per primam.

A follow-up roentgenogram showed free passage of barium from the esophagus into the stomach. A chest film taken November 12th showed a fully expanded lung.

The pathologic report was as follows: Macroscopically, the specimen showed a part of stomach measuring 12 cm. along the lesser, and 16 cm. along the greater, curvature. The proximal end included 1.5 cm. of esophagus. At a distance of 2.5 cm. from the esophageal end there was an orange-sized, well encapsulated tumor mass situated along the greater curvature, measuring 8.5 by 8 by 8 cm. About three-quarters of it was entirely extragastric. The other quarter formed a prominent bulge into the gastric lumen. It was well covered by gastric mucosa except for an ulcerated area measuring 4 by 2 cm. This ulcerated area lead into a subjacent multiloculated cavity, part of which was the size of a large cherry and part the size of a pea. The walls of the cavity were formed by tumor tissue.

FIG. 3. Stomach opened, showing large polypoid tumor in upper portion of fundus of stomach.

On section the tumor consisted of grayish pink rubbery, not hard, tissue which showed waxy interlacing bands, in the interstices of which there were foci containing prominent congested blood vessels. The tumor was well encapsulated. Its exogastric surface showed smooth and nodular areas, all covered by shiny peritoneum. On the gastric side the mucosa and submucosa were freely movable over the encapsulated border of the tumor, except at the site of ulceration and excavation of the tumor previously described. The remainder of the gastric mucosa showed well developed mucosal folds. No tumor nodules were within the remainder of the stomach or within the small parts of fat tissue present within the attached lesser and greater omentum.

The spleen measured 11 by 9 by 4 cm. The cut surface was of a dark hue. Malpighian bodies stood out clearly. The cut surface of the serosa was smooth.

Microscopic examination of the stomach revealed the tumor was well encapsulated. It consisted of interlacing strands and whorls of spindle-shaped cells. (Fig. 4.) The nuclei were

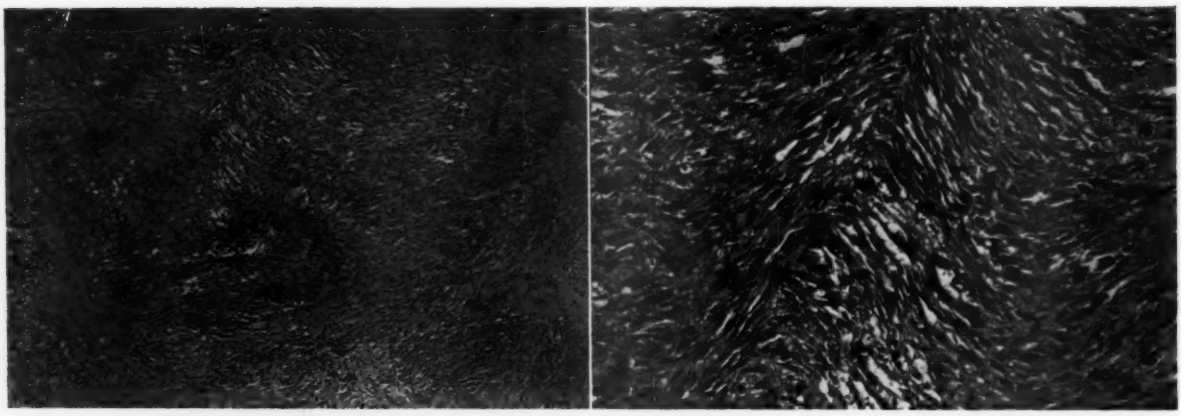

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FIG. 4. Microphotograph, low power, showing interlacing strands and whorls of spindle-shaped cells; × 200.
FIG. 5. Microphotograph, high power, showing rather uniform nuclei, but some appearing vesicular and others dark and dense. Note absence of mitoses; × 800.

rather uniform. Some were stringy, some vesicular, while others were dark and dense. Mitoses were absent or very rare. (Fig. 5.) Their cytoplasm varied from scant to moderately abundant and pale. The tumor was more cellular in the denser, more compact areas and less cellular in the edematous areas. Foci of interstitial hemorrhage were present. The tumor reached to the submucosa of the esophageal end which was lined with regular squamous epithelium. At the site of ulceration there was a dehiscence in the gastric mucosal lining and in the ulcer base formed by necrotic tumor tissue. There was no penetration of the capsule on the serosal aspect of the tumor. The muscular layer of the stomach wall was not infiltrated by tumor tissue and in places fused with the capsule of the tumor.

Examination of the spleen revealed the malpighian bodies were sharply demarcated. The pulp showed extreme congestion.

The following diagnosis was made: (1) Stomach, encapsulated fibroleiomyoma of wall, showing (a) intact capsule of the larger exogastric part and (b) ulceration and necrosis of intragastric part; (2) spleen showed congestion.

SUMMARY AND CONCLUSIONS

Leiomyoma is probably the most common variety of benign gastric tumor. A casual survey of the literature during the past twenty-eight years showed about fifty-seven reports regarding this tumor. Unlike malignant stomach tumors, leiomyoma is usually asymptomatic. Severe hematemesis or melena, leading to secondary anemia, is frequently the only manifestation and occurs when the lesion ulcerates into the gastric lumen. In 20 per cent of our collected series the tumors were situated in close proximity to the gastric cardia. While several features may suggest the possibility of leiomyoma, a correct diagnosis can be made only by histologic study. Despite the fact that this kind of tumor infrequently becomes malignant, the treatment of leiomyoma is surgical. With our present methods and technics, resection can be accomplished regardless of the position of the lesion. (Transthoracic subtotal gastrectomy was performed in two of our fifty-seven collected cases.)

We have reported herein another example of a large paraesophageal gastric leiomyoma successfully removed in a seventy-year old male patient through the transthoracic approach.

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CANCER OF THE SCALP*

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CANCER of the scalp usually has its origin in a superficial lesion, thus making early detection by the patient the rule rather than the exception. Despite this, the results of its treatment are often poor. This may be ascribed to two factors, namely, the natural hesitancy of the patient to consult a physician about an unimpressive painless lesion and the failure of the physician to undertake adequate therapeutic measures at the time of the initial visit. The usual problem has been the old one of "too little, too often." This is especially true with radiation therapy. In many cases a dose of x-ray or other radiation hardly sufficient to cause some regression of the tumor is given initially. This is repeated at irregular intervals until the area shows evidence of over-radiation. Despite this, the cancer thrives.

We present a discussion of the problem, including specific examples of the surgical approach to lesions of varying severity.

Pathology. Cancers of the scalp may be either primary or metastatic. The most common primary tumors are the epitheliomas, squamous or basal-celled. Others occurring less frequently are the carcinomas developing in sebaceous cysts, those that appear in the sweat glands and the entire group of melanomas. It is not unusual to have primary carcinoma in areas of dermatitis, chronically irritated burn scar or in regions of previous radiation therapy.

Involvement of the scalp by metastatic malignancy is unusual. However, metastases may appear in the scalp from any primary lesion, carcinoma of the breast being the most common. Melanoma often spreads widely in subcutaneous lymphatics and thus may secondarily involve the scalp.

Anatomy. A knowledge of the anatomy of the various extracerebral structures is of importance to the surgeon not only for the proper and adequate removal of the lesion, but also to provide an understanding of the reconstructive possibilities. One encounters the following structures: skin, subcutaneous tissue and superficial fascia, the epicranial aponeurosis and occipito-frontalis muscle, a layer of areolar tissue, periosteum of the skull, the bony framework consisting of outer and inner tables and diploe, and finally the meninges, dura, arachnoid and pia. The scalp is nourished by five pairs of major vessels, namely, the supratrochlear and supra-orbital, branches of the ophthalmic artery which in turn arises from the internal carotid artery, the superficial temporal, posterior auricular and occipital branches of the external carotid artery. (Fig. 1.) It is essential that the location of these vessels be known to the surgeon, since the utilization of a pedicled scalp flap in the reconstruction of massive defects may be the procedure of choice. Its success will depend on the presence of one of these major vessels within the flap.

Venous drainage of the scalp is accomplished by veins accompanying the aforementioned arteries. It is important to note that the diploe is drained by four pairs of veins which empty into both the intracranial venous sinuses and surface vessels. Thus there is a direct venous pathway from the scalp, through the skull, to the cranial contents. The arterial supply of the diploe is from the meningeal and pericranial arteries.

The dura receives arterial blood from the middle meningeal artery. Venous return is provided by the superior sagittal sinus.

The lymphatic drainage of the scalp is well established. The anterior portion of the scalp drains into the nodes of the face, the temporal and parietal regions into parotid and mastoid nodes and the occipital area into occipital nodes.

Treatment. A number of factors influence the type and degree of therapy of cancer of the scalp, namely, the size of the lesion, its

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pathologic diagnosis, previous treatment, the age of the patient and the extent of the lesion with invasion of skull, dura or brain.

In the past, many scalp malignancies have been treated with x-ray therapy. Despite the radiosensitivity of the epitheliomas, we should

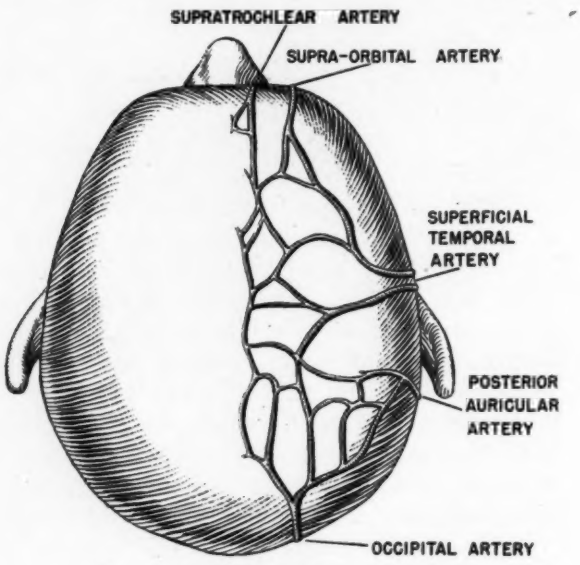

FIG. 1. Arterial supply to the scalp.

like to raise several objections to the use of radiation of the scalp. First, the scalp lies in immediate proximity to bone; radiation in adequate dosage to destroy a superficial cancer may devitalize this underlying bone and make it susceptible to a late osteomyelitis and ultimate slough of the involved portion. Secondly, considerable question has been raised recently as to the possibility of serious brain damage resulting from heavy radiation of the head. Pendergrass et al.[1] reported three cases of intracranial infections which they believed were directly caused by x-ray therapy given for cancer of the scalp. It is difficult to prove that the radiation was responsible for the subsequent infections; however, if there is even a reasonable chance of such a sequence of events and if we have other satisfactory methods of treatment, it seems sensible to avoid radiation. A third less weighty objection is the depilation caused by radiation.

If the lesion is small, roughly 2 cm. or less, it may be easily excised under local anesthesia, and the skin and soft tissue defect closed per primum. A lesion of this size, particularly an epithelioma, could be treated by means of radiation. If that method were to be used, we would recommend low voltage x-ray administered through as small a port as possible. A cancerocidal dose would thus expose minimal areas of skull and brain to x-rays and possible later morbidity.

If the lesion is larger than one in which the defect may be primarily closed, we believe

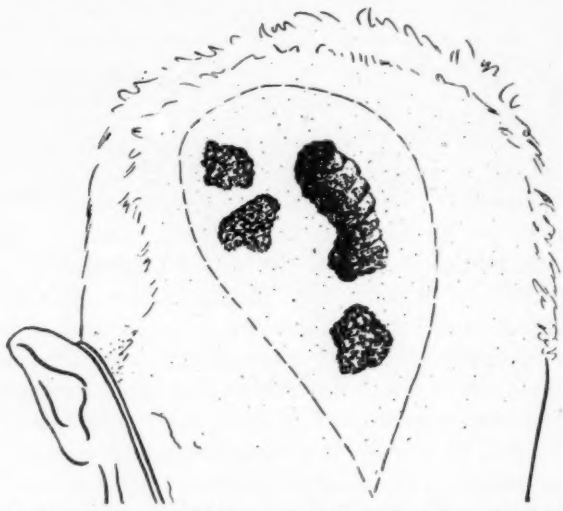

FIG. 2. Case 1, carcinoma of scalp; sebaceous gland in origin; diagrammatic sketch.

that it should be totally excised and the remaining defect covered with skin and subcutaneous tissue if necessary as a plastic procedure.

In many cases an insufficient amount of radiation has been given a lesion before it arrives for further treatment. It must be remembered that the effects of radiation on the tissues are cumulative. If an area has received such radiation previously at any time, its present or future tolerance to such therapy is decreased, and it is probably impossible to administer a cancerocidal dose safely. The physician who undertakes the initial treatment of cancer of the scalp has the best chance of sterilizing the lesion; this initial therapy must be sufficiently radical. However, if a recurrent cancer (one which had too little initial radiation or repeated doses of insufficient therapy) is seen in a scalp, the further treatment is radical surgery.

One is influenced considerably in therapy by the pathologic diagnosis of the lesion. As mentioned before, the epitheliomas are radiosensitive. However, the adenocarcinomas originating in sweat glands, or the melanotic cancers, are radio-resistant, and should never be subjected to radiation. For these, surgical excision is always the procedure of choice.

The size of the cancer influences treatment

FIG. 3. Case I, postoperative appearance after excision of carcinoma of scalp and application of skin graft on periosteum.

only in terms of the post-excision reconstructive problem. If a lesion involves only skin and subcutaneous tissue, it is excised and defect closed per primum or covered with a split skin graft. Such a graft will take satisfactorily on skull which is covered with periosteum. If bone is involved in the malignant process, it must be resected, and the graft applied directly on dura. If dura and perhaps brain substance must be removed, a pedicled skin flap must be elevated to cover the defect. If such a flap is to be sizable, it must be delayed prior to its transfer to assure an adequate blood supply.

We present three typical cases, illustrating our approach to cancer of the scalp of varying size and extension.

CASE REPORTS

CASE I. T. M. was a sixty-eight year old white male who entered the hospital with ulceration of the scalp, allegedly the result of multiple "wens" which had been present for thirty years. (Fig. 2.) Four years prior to entry, one of these wens had started to drain, with the formation of a gradually enlarging ulcerated area. Examination of the scalp on

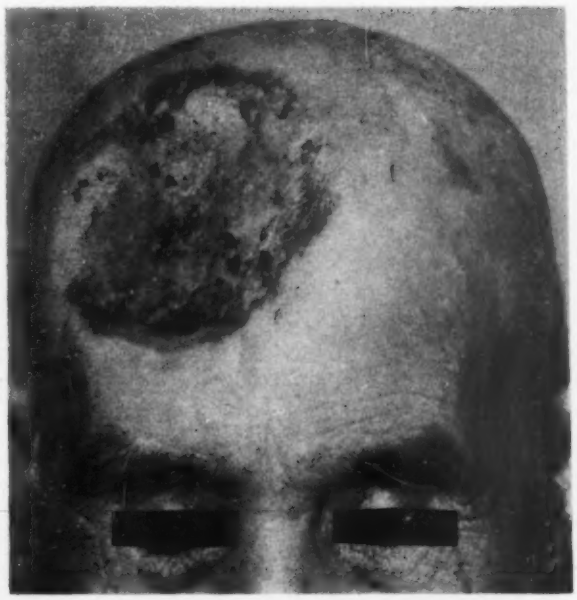

FIG. 4. Case II, cancer of scalp in a seventy-nine year old white male; involved skull.

entry showed two foul-smelling ulcerations measuring 3 by 3 cm., with raised irregular surfaces, in the right frontoparietal region. There was also a third non-ulcerated nodule. All three areas were firm and non-tender. Biopsy of one of the ulcer margins showed

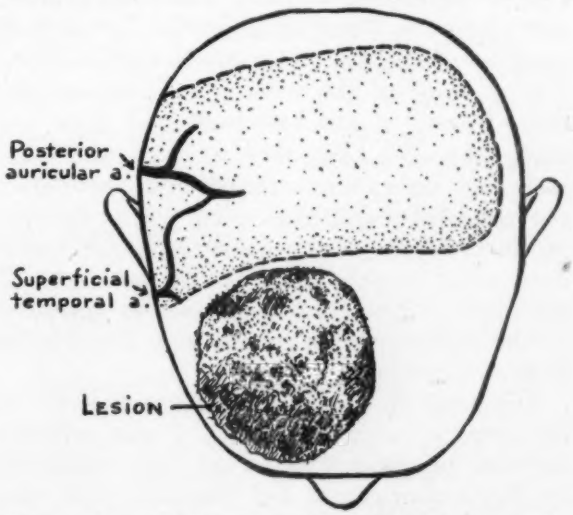

FIG. 5. Case II, diagrammatic sketch of cancer and outline of full thickness pedicled flap; flap was delayed one time before actual transplant onto the defect.

carcinoma of sebaceous gland origin. On May 8, 1948, the entire area of involvement was excised down to the periosteum, and the remaining 15 by 10 cm. defect covered with a split skin graft taken from the thigh. The operative result was satisfactory. (Fig. 3.)

FIG. 6. Case II, postoperative appearance; the flap diagrammed in Figure 5 was transplanted onto the defect directly onto cortex; 100 per cent take; no cerebrospinal fluid leakage.

To date there has been no evidence of recurrent disease.

CASE II. A seventy-nine year old white male was admitted to the hospital with an ulcerated lesion allegedly treated with small doses of radiation at irregular intervals, in spite of which it gradually increased in size. Examination on admission showed a 6 cm. ulceration of the right frontal area. The scalp had been completely eroded, bone was exposed and there was a ring of ulceration in the skull itself, involving the outer but not inner table. The margins of the ulcer were irregular and firm. Biopsy of the lesion showed basal cell carcinoma. On December 9, 1947, the area, including bone, was excised and the defect covered with a split skin graft placed directly on dura. The patient's course was uneventful until eight months after operation, at which time two granulomatous ulcerations appeared on the graft which on biopsy were found to be recurrent carcinoma. (Fig. 4.)

The patient was therefore readmitted to the hospital. A scalp flap (Fig. 5) was partially elevated on August 30, 1948, and redelayed on September 24th. On October 13th the previously grafted area, including dura, was totally excised. The sagittal sinus was ligated. The previously prepared pedicled flap was placed directly over cortex and sutured to the wound margins. The residual soft tissue defect was covered with a split skin graft. The postoperative course was complicated by a probable thrombosis of the left middle cerebral vessels on the fifth postoperative day. This was treated with dicumarol® and stellate ganglion

FIG. 7. Case III, cancer of scalp invading skull and dura.

blocks, with complete recovery within a week. Since then he has been entirely asymptomatic and free of disease. (Fig. 6.)

CASE III. G. C., a seventy-four year old white male, presented a history of having had an ulcerated lesion of the scalp of eight

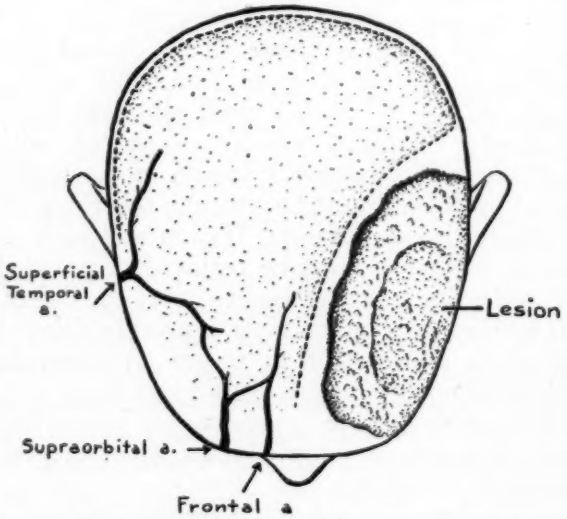

FIG. 8. Diagrammatic sketch of lesion in Case III and proposed scalp flap to cover the surgical defect; it was nourished by two main arteries.

years' duration. It was reported that the lesion had been treated with an unknown amount of x-ray therapy three years later, with alleged healing. The lesion is said to have broken down again one and a half years before entry, when the patient was struck on that

area by a piece of heavy machinery. The lesion apparently became infected, requiring incision and drainage. The resulting ulcer remained unhealed. On examination (Fig. 7) a 12 by 9 cm. ulcerated lesion of the left frontoparietal region was found. The scalp and skull were absent in that area; the dura was exposed and pulsating. Biopsy of the lesion was reported as basal cell carcinoma. On December 24, 1947, a large pedicled flap was delayed (Fig. 8); it was redelayed on January 17, 1948. On March 6, 1948, the lesion, including scalp, bone, dura and some cortex, was excised and the previously delayed pedicled flap rotated into the defect. It was sutured in position with the inferior surface of the flap in direct contact with brain substance. The remaining scalp defect was covered with a split skin graft. The postoperative course was uneventful with primary healing throughout. (Fig. 9.)

FIG. 9. Case III, huge scalp flap transplanted over defect at time of excision of the cancer, directly onto cortex; no cerebrospinal fluid leakage; no evidence of cortical irritation.

SUMMARY

A discussion of the treatment of cancer of the scalp is presented. Three cases illustrating varying degrees of involvement are presented along with the treatment carried out in each case.

CONCLUSIONS

1. The treatment of cancer of the scalp is preferably surgical.
2. If the lesion is confined to scalp only, it may be excised and the defect closed per primum or by skin graft, depending on size.
3. If the calvarium is involved, the involved portion is removed with the specimen and defect closed by grafting over dura.
4. If the dura is also involved, it may also be excised with the specimen and a skin flap may be grafted immediately upon brain tissue.
5. No evidence of cortical irritation was noted in the two cases in which large skin flaps were placed on cerebral tissue.
6. No evidence of spinal fluid leak or infection was noted in the two cases in which the skin flaps were grafted over cerebral tissue.

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To date there has been no evidence of recurrent disease.

CASE II. A seventy-nine year old white male was admitted to the hospital with an ulcerated lesion allegedly treated with small doses of radiation at irregular intervals, in spite of which it gradually increased in size. Examination on admission showed a 6 cm. ulceration of the right frontal area. The scalp had been completely eroded, bone was exposed and there was a ring of ulceration in the skull itself, involving the outer but not inner table. The margins of the ulcer were irregular and firm. Biopsy of the lesion showed basal cell carcinoma. On December 9, 1947, the area, including bone, was excised and the defect covered with a split skin graft placed directly on dura. The patient's course was uneventful until eight months after operation, at which time two granulomatous ulcerations appeared on the graft which on biopsy were found to be recurrent carcinoma. (Fig. 4.)

The patient was therefore readmitted to the hospital. A scalp flap (Fig. 5) was partially elevated on August 30, 1948, and redelayed on September 24th. On October 13th the previously grafted area, including dura, was totally excised. The sagittal sinus was ligated. The previously prepared pedicled flap was placed directly over cortex and sutured to the wound margins. The residual soft tissue defect was covered with a split skin graft. The postoperative course was complicated by a probable thrombosis of the left middle cerebral vessels on the fifth postoperative day. This was treated with dicumarol® and stellate ganglion blocks, with complete recovery within a week. Since then he has been entirely asymptomatic and free of disease. (Fig. 6.)

FIG. 7. Case III, cancer of scalp invading skull and dura.

CASE III. G. C., a seventy-four year old white male, presented a history of having had an ulcerated lesion of the scalp of eight years' duration. It was reported that the lesion had been treated with an unknown amount of x-ray therapy three years later, with alleged healing. The lesion is said to have broken down again one and a half years before entry, when the patient was struck on that

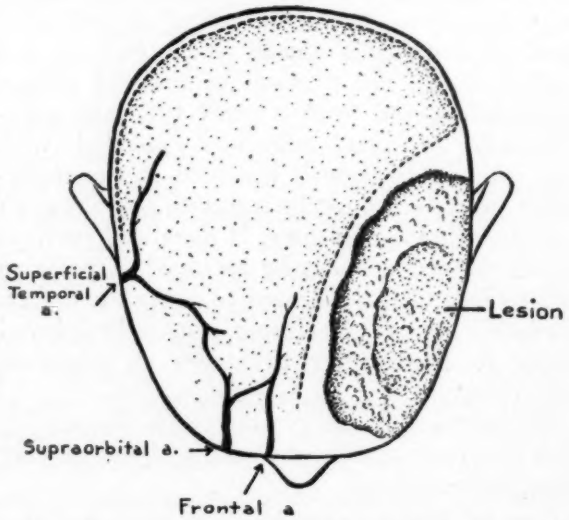

FIG. 8. Diagrammatic sketch of lesion in Case III and proposed scalp flap to cover the surgical defect; it was nourished by two main arteries.

area by a piece of heavy machinery. The lesion apparently became infected, requiring incision and drainage. The resulting ulcer remained unhealed. On examination (Fig. 7) a 12 by 9 cm. ulcerated lesion of the left frontoparietal region was found. The scalp and skull were absent in that area; the dura was exposed and pulsating. Biopsy of the lesion was reported as basal cell carcinoma. On December 24, 1947, a large pedicled flap was delayed (Fig. 8); it was redelayed on January 17, 1948. On March 6, 1948, the lesion, including scalp, bone, dura and some cortex, was excised and the previously delayed pedicled flap rotated into the defect. It was sutured in position with the inferior surface of the flap in direct contact with brain substance. The remaining scalp defect was covered with a split skin graft. The postoperative course was uneventful with primary healing throughout. (Fig. 9.)

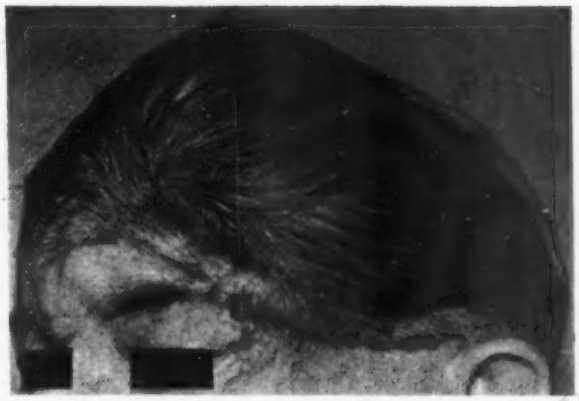

FIG. 9. Case III, huge scalp flap transplanted over defect at time of excision of the cancer, directly onto cortex; no cerebrospinal fluid leakage; no evidence of cortical irritation.

SUMMARY

A discussion of the treatment of cancer of the scalp is presented. Three cases illustrating varying degrees of involvement are presented along with the treatment carried out in each case.

CONCLUSIONS

1. The treatment of cancer of the scalp is preferably surgical.
2. If the lesion is confined to scalp only, it may be excised and the defect closed per primum or by skin graft, depending on size.
3. If the calvarium is involved, the involved portion is removed with the specimen and defect closed by grafting over dura.
4. If the dura is also involved, it may also be excised with the specimen and a skin flap may be grafted immediately upon brain tissue.
5. No evidence of cortical irritation was noted in the two cases in which large skin flaps were placed on cerebral tissue.
6. No evidence of spinal fluid leak or infection was noted in the two cases in which the skin flaps were grafted over cerebral tissue.

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SELF-ADJUSTING, SELF-LOCKING HIP BOLT*

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ANALYSIS of internal fixation devices for the treatment of fractures of the neck of the femur indicates that each falls into one of four classes, namely, nails, screws, bolts or an intermediate group using features common to nails, screws and bolts. The Smith-Petersen and Thompson nails are good examples of the first type. The Johnston screw-key and Harmon's threaded screws are typical screws. Cleary and Morrison's self-releasing lock-bolt illustrates the third class. Examples of the intermediate group include the Moore pins, the lag-screw of Lorenzo, the stud-bolt screw of Godoy-Moreira and Lippmann's cork-screw bolt. It is recognized in mechanical construction that a screw holds better than a nail and a bolt holds better than a screw. However, because of convenience of application certain structures may be fixed more readily with a nail than a screw or with a screw than a bolt. Each class has certain inherent advantages and disadvantages.

Nails have the advantage of being simple and usually of one piece. A few are adjustable in length by cutting. The shapes in cross section, such as three-flange, Z or V, prevent rotation between the fragments. The disadvantages are as follows: Nothing exists within the nail to maintain impaction between the two bone fragments and when once inserted the nail is of fixed length. If appreciable absorption occurs at the fracture site, migration of the nail either outward, inward or both results.

Screws possess the feature of impacting the two fragments and of holding these fragments in apposition. These are distinct advantages. On the other hand, since they are of fixed length, an assortment of sizes must be at hand. If absorption at the fracture site occurs, the fragments are no longer held together and rotation of the head on the neck is permitted. This deficiency has been corrected in the Johnston screw-key by the introduction of a flat bar in a slot on the side of the device. As absorption at the fracture site proceeds, the screw migrates outward. If this is prevented, the fragments may actually be held apart.

Bolts have not been used to any extent. Cleary and Morrison constructed one with arms which extrude into the head and with a nut at the distal end of the bolt for tightening. The bolt is of fixed length, the arms which extrude into the head do not present sufficient bearing surface and following absorption at the fracture site rotation between the fragments is permitted.

A large intermediate group utilizes a combination of features found in screws and bolts. The majority of these devices have a wide-threaded proximal end with a nut applied distally. Their ability to compact the fragments and hold them together is of definite advantage. However, as with screws and bolts, after appreciable absorption at the fracture site has taken place the fragments are no longer held in apposition, rotation of fragments is permitted and the devices migrate outward.

A device better adapted for internal fixation of femoral neck fractures should possess, it is believed, certain essential characteristics. From the standpoint of the operator the appliance should be a single unit, simple and easily applied; nails usually possess this feature. It should also be adjustable as to length; some nails come in different sizes while others can be cut. Screws and bolts are of necessity of different lengths; unfortunately, surgeries are not always stocked with a sufficient range of sizes. The device should be of small diameter to permit of oblique or more vertical insertion. To be more effective the appliance should *hold the fragments impacted.* Although an attempt is made to produce impaction when a nail is employed, the fragments are often but held in apposition. Screws and bolts, on the other hand, inherently possess this desired quality. The device should *prevent rotation of the fragments.* Nails accomplish this but most screws and bolts fail on this point. It should be *self-adjusting,* automatically compensating for any

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bone absorption which might occur. It is neither desirable nor practical to subject a patient to repeated surgery in order to readjust the fixation apparatus as absorption occurs. It should be *self-locking*, that is, it should permit shortening but prevent lengthening. The self-adjusting, self-locking features are requisites for maintaining continued impaction despite absorption. During the past six years one of the writers (M. G. H.) has endeavored to design a fixation device possessing the aforementioned features. The device possesses, it is believed, advantages not previously utilized.

accessible to the operator at all times, may be rotated by a screwdriver passed into the hollow piston. A flange hinged to the distal end of the piston is attached to the lateral shaft of the femur by means of a screw. Because of the sliding mechanism the bolt comes in two lengths only. The shorter has a range from 8 to 10.8 cm. and the longer from 9.5 to 13.8 cm. Thus the two sizes overlap 1.3 cm. in length. (Fig. 2.) The locking mechanism holds the smallest degree of take-up. The bolt is so designed that rotation between the segments is prevented.

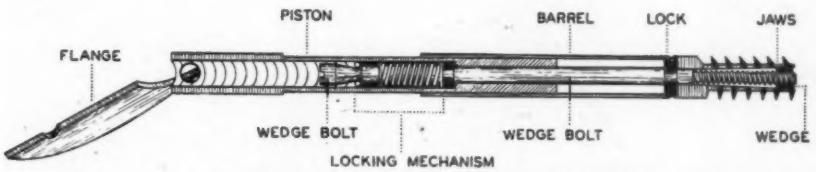


FIG. 1. Longitudinal section of self-adjusting, self-locking hip bolt.

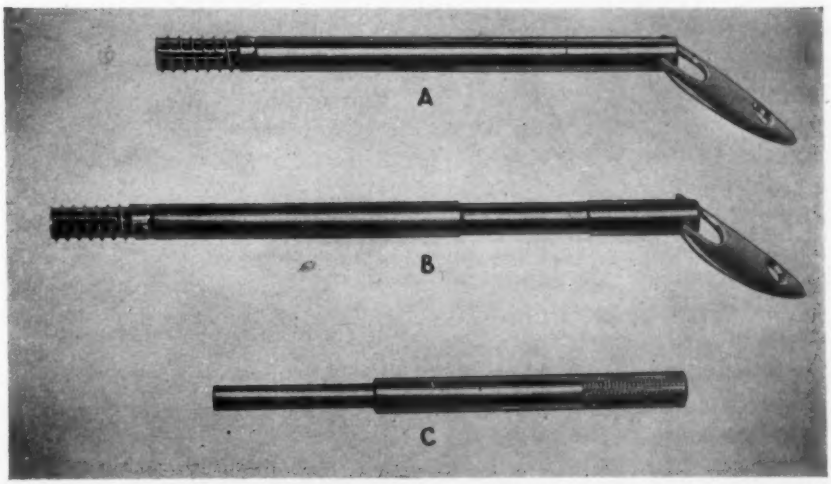


FIG. 2. Self-adjusting, self-locking hip bolt seen in (A) shortened position, (B) lengthened position. The (C) inserter-key used when inserting or relengthening bolt.

The bolt is constructed of stainless steel and is 5/16 inch in diameter. It is a one-piece device so far as the operator is concerned, so constructed that it cannot be taken apart. The body of the bolt comprises an outer (barrel) and an inner (piston) segment, one sliding within the other. (Fig. 1.) The proximal end of the barrel consists of four jaws which have deep wide threads, ten to each inch, cut on their outer surfaces. The jaws, 2 cm. in length, may be expanded by the movement of a wedge located between them. The wedge is threaded on a long slender bolt which passes through the length of the body. This wedge-bolt, readily

PROCEDURE

The method of insertion consists of drilling one or more guide wires all along the line chosen for the placement of the bolt. (Fig. 3.) A hollow drill 5/16 inch in diameter is drilled to the estimated depth over the wire selected from roentgenograms. (Fig. 4.) The bolt is held in the lengthened position by the inserter-key while being introduced into the hole prepared. Using an ordinary screwdriver the wedge-bolt is turned and the jaws expanded. The flange is then pushed up against the shaft and fixed by a screw. After it has been fitted correctly the bolt should provide a minimum of

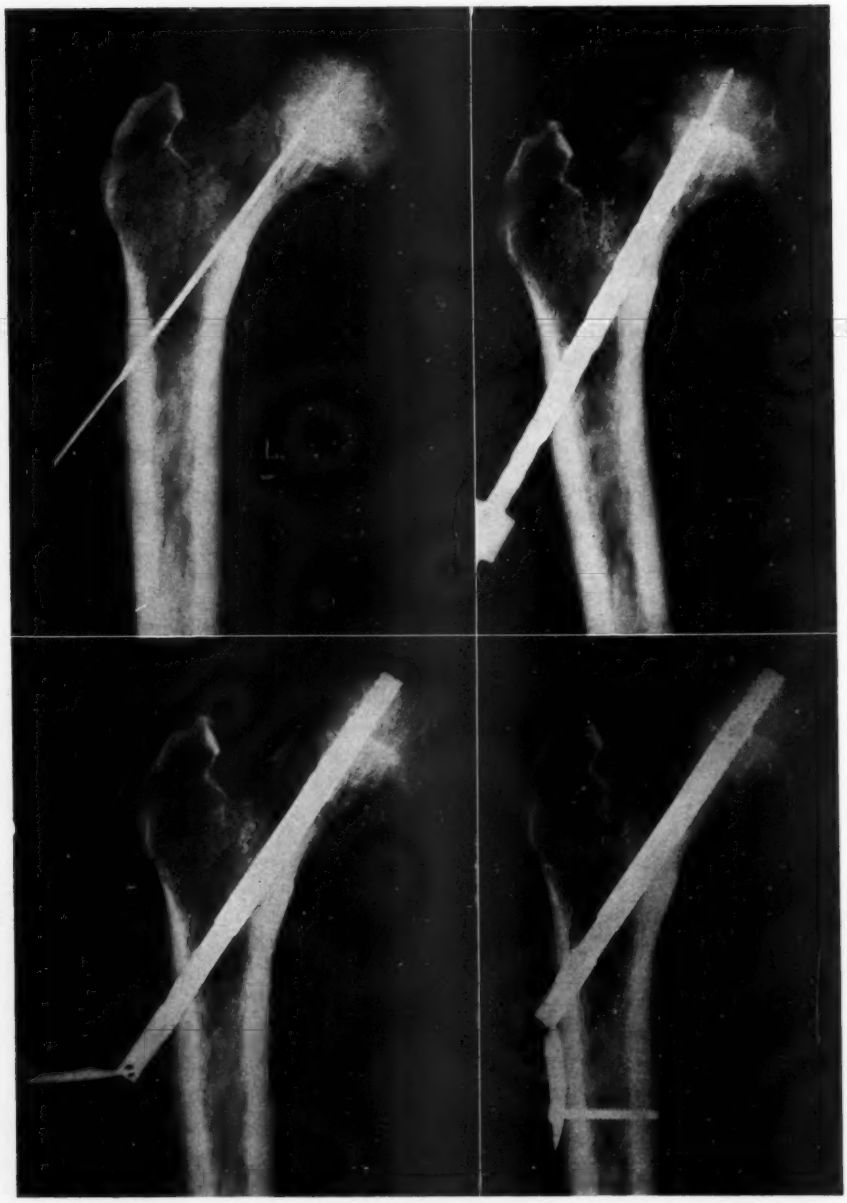


FIG. 3. A, Kirschner wire is placed satisfactorily; B, 5/16 inch hollow drill is drilled over wire to appropriate depth; C, hip bolt is slipped into the prepared hole in lengthened position; D, flange is pushed up against the shaft and fastened by a screw.

1.25 cm. take-up for any possible postoperative absorption. The average time required for insertion of the hip bolt is no longer than that required for the introduction of other internal fixation devices.

COMMENTS

The hip bolt is simple and easy to use. Because of its adjustable length it requires neither cutting nor bending to insure perfect fit. Its round form permits of insertion without hammering; shock to the patient is thus minimized. Its small diameter makes oblique or more vertical fixation possible. Rotation between the fragments is not permitted because the head is held firmly by the expanded jaws on the proximal end of the barrel, the barrel and piston of the bolt cannot rotate one upon the other and the distal end of the piston is fixed to the shaft by a flange. Automatic adjustment occurs for any degree of bone absorption since shortening of the bolt is freely permitted.

This shortening occurs as a result of muscle tension or weight thrust as the patient either turns on the side in bed or later walks. The bolt is self-locking in any position, that is, it can shorten but can only relengthen when the special key-inserter is used to release the mechanism. This eliminates any possible movement between the fragments which are continuously held impacted. Because of the self-adjusting mechanism the weight thrust is at the fractured surfaces, a factor which favors bone healing.

The bolt may easily be removed even after bony growth has occurred between the jaws. By means of an ordinary screwdriver the wedge-bolt is turned forcing the wedge inward. This breaks up the bone between the jaws and the resilient jaws retract almost completely. The screw holding the flange to the shaft is unscrewed and the bolt slipped out. If resistance is met, the bolt may be removed by unscrewing it using the flange as a lever. The threads on the outside of the jaws make this operation possible.

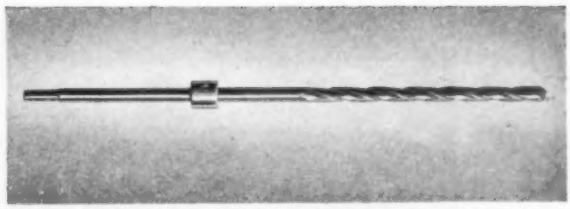


FIG. 4. Three-fluted, 5/16 inch diameter hollow drill, 30 cm. in length.

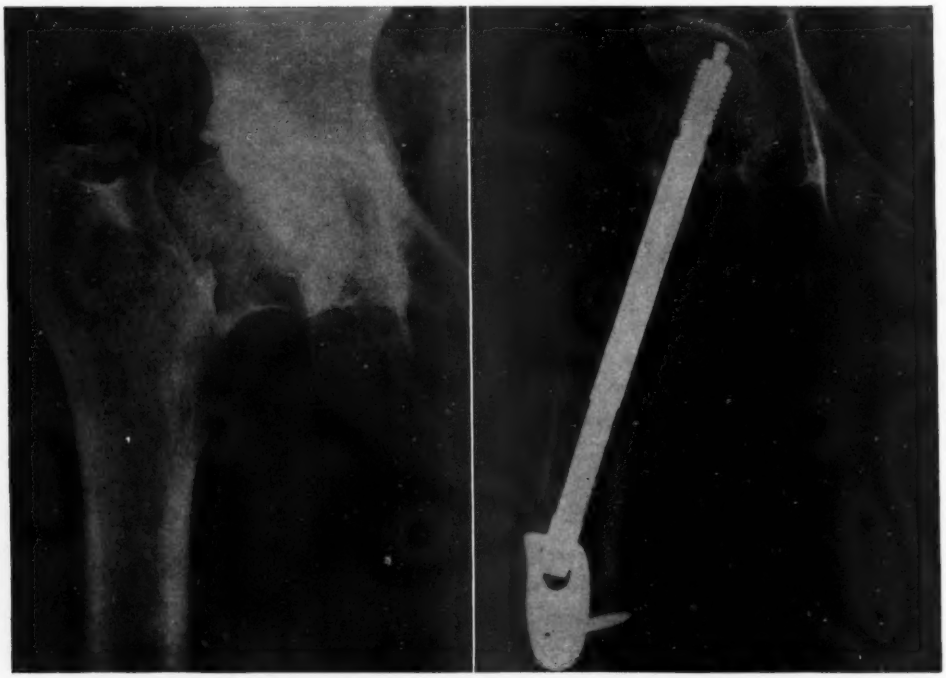
firm in this location. Whether the expanding of the bolt within the head would fracture the bone in this region was also considered. Before clinical trial the bolt was expanded in several femoral heads obtained from fresh cadavers. As much force as could be exerted by a large-handled screwdriver was employed. In none of the specimens did any crack appear. The handle of the screwdrivers used in surgery are smaller so that the maximum possible pressure exerted is much less than that used in the test series. Roentgenograms have revealed no injury to the femoral heads due to expansion of the jaws even when the tip was placed close to the cortex.

5A 5B 5C

FIG. 5. Case 1. A, fracture, earlier model hip bolt used for internal fixation; B, fracture line obliterated; C, lateral view showing expanded jaws. Later bolts were constructed with four jaws.

When the expansion principle was first used in the bolt, the question arose whether the constant force thus exerted would cause pressure atrophy and bone absorption within the head. Some of the early cases have been followed up with roentgenograms for six years. Although absorption in the region of the fracture site has occurred, no absorption has been observed within the head, the bolt remaining

In the development of the hip bolt twenty fractures of the femoral neck have been treated. This number is not large. However, each case has been critically observed and changes in the construction and design of the bolt have been progressive. The bolts used early in the series lacked the quality of self-adjusting and self-locking. (Fig. 5.) When absorption at the fracture site was slight, healing occurred.



6A 6B

FIG. 6. Case II. A, fracture, self-adjusting, self-locking hip bolt used for fixation; B, callus obliterating fracture; note oblique position of fixation device.

When this absorption was appreciable, the bolt became too long and migrated distally. The features permitting the bolt to shorten automatically for bone absorption and the locking mechanism to hold the fragments impacted were later added. (Fig. 6.)

CASE REPORTS

CASE I. B. L., a female aged forty-six, sustained a subcapital comminuted fracture of the left femur on December 31, 1943. Excellent reduction and fixation with a hip bolt (early type) were obtained four days later. At three months weight-bearing with crutches was permitted. At six months the fracture line was obliterated with callus. Patient continued to walk without a limp or pain.

CASE II. C. E., a female aged sixty-five, fractured the neck of the right femur on May 2, 1945. Internal fixation was done with a self-adjusting, self-locking hip bolt. Because of good reduction and fixation weight-bearing was started after four weeks. Two months later because of pain weight-bearing was discontinued. Patient, however, continued to walk and nine months postoperatively had normal hip function. Further returns to the hospital indicated no hip complaints.

SUMMARY

A classification and analysis of internal fixation devices for the treatment of fractures of the neck of the femur are made.

A description is given and a preliminary report made of a self-adjusting, self-locking hip bolt. The hip bolt is of small diameter and is adjustable in length to simplify insertion. Once inserted rotation of fragments is prevented, absorption at fracture site is compensated for automatically, weight thrust is without interference between fracture surfaces and impaction is assured at all times due to the self-locking feature.

Acknowledgment: Appreciation is expressed to Dr. Isaac Berry and Dr. Claren H. Jesse for the clinical use of the hip bolt and for their many helpful suggestions. Acknowledgment is made to Dr. Alfred E. Gallant, Dr. Joseph Risser, and Dr. G. Mosser Taylor on whose services at the Los Angeles County General Hospital this work was done.

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Investigators have recently discovered that propylthiouracil is both safer and more effective than plain thiouracil for the medical treatment of hyperthyroidism. The initial dosage is 100 to 150 mg. daily, giving 25 to 25 or 40 mg. every six hours. If the patient has no intolerance to this drug, he or she might even take 250 mg. daily but beyond this figure of daily intake no greater improvement occurs. So the average patient does best on 100 to 250 mg. daily in four divided doses. The drug may be effectively used as long range preoperative preparation or, as a substitute for surgery, especially in patients who are poor surgical risks. However, I can foresee the day when this or a better, more potent and safer drug will make surgical work absolutely unnecessary in Grave's disease. However, when a nodular goiter is present, irrespective of whether it is associated with hyperthyroidism or not, surgery is indicated to forestall the possibility that one of the nodules is malignant or may become so soon. (*Richard A. Leonardo, M.D.*)

TANTALUM TUBES IN THE NON-SUTURE METHOD OF BLOOD VESSEL ANASTOMOSIS*

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THE purpose of this article is to add tantalum to the list of materials out of which prostheses for use in the non-suture method of blood vessel anastomosis have been made.

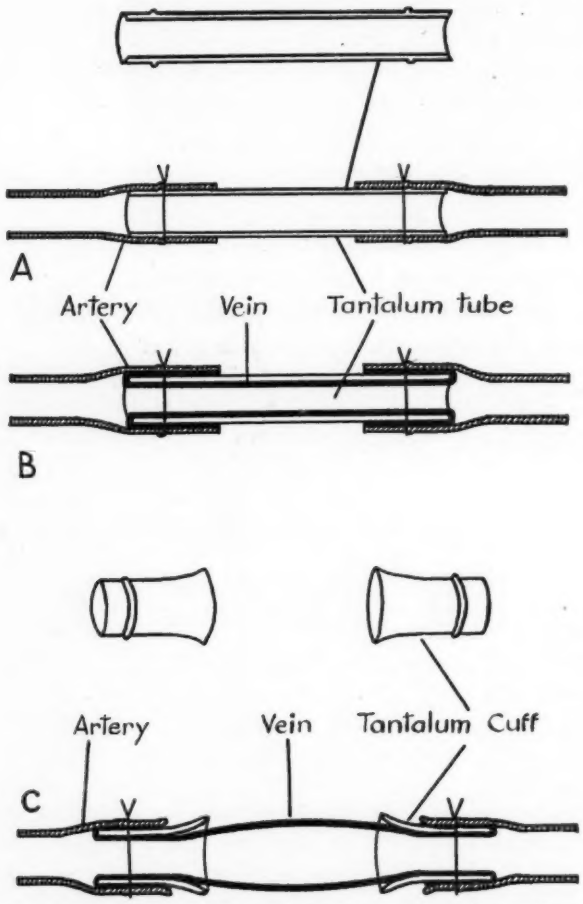

FIG. 1. Methods of employment of tantalum tubes and cuffs; A, unlined tube placed in arterial defect; B, similar tube, but lined with vein; C, vein graft utilizing two flanged and ridged tantalum cuffs.[7]

The first mention of the non-suture technic which we have found in the literature appears in an article by Queirolo.[1] This investigator was studying the function of the liver in animal experiments and used a short glass tube to produce an end-to-end portal-caval anastomosis. The end of the portal vein was brought through the glass cuff, everted over it and made fast with a ligature. The vein-covered tube was then inserted into the end of the vena cava and fastened with a second ligature. Thus the essential features of the non-suture method have been known for over half a century.

In 1897 Nitze[2] demonstrated an ivory cuff which was used exactly like the glass tube of Queirolo. In 1900 Payr[3] mentioned that the prosthesis might be made of glass, celluloid, aluminum, hard rubber and precious metals, but he advocated the use of a metal which he believed was fully resorbable, namely, magnesium. He stated that the gas cysts found in the rabbit and guinea pig after implantation of magnesium were not observed in larger animals. The exact details of his experiments were not given and he did not relate an instance of the use of the magnesium cuff in a clinical case. In his acute physiologic experiments, Heymans[4] used Payr cuffs made of brass.

The non-suture method was largely in the discard for forty years due to the success of the suture methods with which the names of Jaboulay and Briau[5] and Alexis Carrel[6] are associated. However, in 1942 the report of Blakemore, Lord and Stefko[7] stimulated new interest in the non-suture technic. These authors realized that there was a need in the management of arterial injuries sustained in warfare for a method which did not demand the meticulous technic of the suture method. Their tubes and cuffs were made of the alloy vitallium® and they advocated the use of vein grafts to bridge arterial defects. In 1945 they stated,[8] "With careful attention to the details of technic, asepsis and the use of a generous segment of femoral vein from the opposite leg, our non-suture method affords a 90 per cent expectance of success in bridging defects of the small femoral arteries of dogs with and without the use of anticoagulants."

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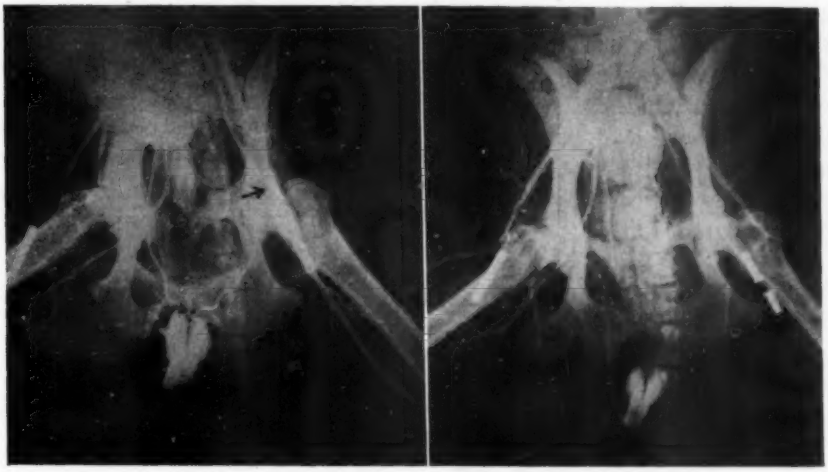

2A 2B

FIG. 2. A, arteriogram (diodrast) showing a successful vein graft between cuffs on the animal's left; on the animal's right, there has been occlusion of a vein-lined tube; arrows point to tantalum cuffs. B, arteriogram showing failure of anastomoses by both methods (seven weeks); note the excellent collateral circulation.

Recently, Swenson and Gross[9] have reported excellent results in vein anastomosis using absorbable fibrin tubes. On the other hand, Johns[10] has carried out experiments comparing the suture and non-suture methods in splenorenal vein anastomoses in dogs. The suture technic resulted in 72.7 per cent patency; the non-suture technic in only 17.2 per cent. It will be remembered that such vein-to-vein anastomoses do not present the favorable differentials in pressure which are present in arterial repairs.

It appeared to be desirable to determine the value of tantalum prostheses in the non-suture technic. This metal is biologically inert and has been used successfully in several fields of surgery, notably in neurosurgery, in which it has had special value in the form of plates to cover cranial defects.

From stock lengths of seamless tantalum tubing measuring ⅛ inch in diameter, a number of tubes and cuffs were appropriately shaped on a lathe.*

The tantalum prostheses were used to reestablish the continuity of the sectioned femoral arteries in twenty-five dogs. In nine arteries the anastomosis was performed by inserting a simple 1-inch unlined tube in the distal and proximal ends of the severed vessel. (Fig. 1A.) In six arteries the tubes were treated with a coating of paraffin. In eighteen arteries the

FIG. 3. Excised specimen showing functioning vein graft between two segments of femoral artery; a wooden probe has been passed through the anastomotic area.

1 inch tube was lined with the corresponding femoral vein. (Fig. 1B.) Fourteen times the defect was bridged by a segment of vein attached to the artery by means of the shorter cuffs. (Fig. 1C.)

The technic of the non-suture method which has been so well described by Blakemore and his associates was followed meticulously. With the animal under nembutal® anesthesia, the femoral vessels were exposed; and if a vein for lining the tube was desired, a segment of the proper length was removed between ligatures and immediately irrigated with saline. The distal end was marked to be applied to the proximal end of the artery so that the valves would not interfere with blood flow. The artery was divided between bulldog clamps, after which the continuity was reestablished by one of the methods illustrated in Figure 1.

The arterial reconstructions were investigated at varying times to determine their patency. The presence or absence of a pulse in

* The tantalum tube stock was furnished by Dr. Herbert L. Davis of Ethicon Suture Laboratories, New Brunswick, N. J.

the femoral artery distal to the anastomosis was not a reliable sign; a pulse was not palpable in some arteries when exploration revealed a functioning anastomosis, while a distinct pulse due to the collateral back flow was noted in some with occlusion. Definite evidence as to patency was obtained by exposure of the vessel at operation or by radiography after diodrast injections.

Results. The nine unlined tubes were all occluded by thrombi when investigated. This was true of two examined only four hours after the anastomosis. Coating the tubes with paraffin did not lessen the incidence of thrombosis.

When the tubes were lined with veins, (Fig. 1B) two-thirds of them were found to be patent when examined at intervals varying from four hours to two months. Several factors were thought to predispose to failure in the six tubes which were thrombosed. Two of the wounds were grossly infected. In one tube the vein was found to be twisted and in another the vein segment was distorted by a large number of silk ligatures which had been applied to tributaries. There was one instance of early secondary hemorrhage because of an insecure anastomosis.

The best results were obtained with the use of vein grafts placed between two short tantalum cuffs. (Fig. 1C.) A patent anastomosis resulted in twelve of fourteen attempts. This is just about equal to the "90 per cent expectance of success" mentioned in the quotation from Blakemore and Lord[6] previously given. Diodrast arteriograms on a successful and an unsuccessful experiment with this method are shown in Figure 2. When patency was present, the excised specimens showed a smooth intimal surface lining the tubes and connecting them. (Fig. 3.)

SUMMARY

Tantalum prostheses were used to anastomose the sectioned femoral arteries in twenty-five dogs. It was necessary to line the tubes with veins in order to prevent thrombosis. The best results (86 per cent patency) were obtained with a vein graft between two short cuffs. It would appear that tantalum is as good as vitallium® or any other material which has been used for this purpose.

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Streamlined Articles

NOTES ON THE RETENTION OF PANTOPAQUE IN THE SUBARACHNOID SPACE*

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IN this article the technic of pantopaque myelography without removal of the contrast media as done at The National Hospital, Queen's Square, London, England, is described. A follow-up study was made of twenty-five patients in whom up to 6 cc. of pantopaque had been left in the subarachnoid space. No symptoms chargeable to pantopaque retention appeared in any case. Fixation of pantopaque as a large mass occurred only once although small drops became fixed in most of the cases. This represents a reaction in the subarachnoid space. The absorption rate is extremely variable. It does not progress steadily but varies with the amount of pantopaque present in the subarachnoid space.

* * * *

Ethyliodophenylundecylate (pantopaque, myodil) has become the myelographic contrast medium of choice in most clinics.[2,3,7–13,15–17] Its popularity is based upon its good roentgenologic qualities, the ease with which it can be removed from the subarachnoid space, the apparent lack of meningeal reaction of it and its absorbability from the subarachnoid space.

The standard procedure of most clinics in this country is to remove the pantopaque following completion of the x-ray examination. However, at The National Hospital in London, England, pantopaque has always been left in the subarachnoid space following contrast myelography. A follow-up study of patients examined with this technic has been done in order to find out if any sequelae chargeable to this technic have appeared.

Materials. An attempt was made to see all inpatients of The National Hospital who had had pantopaque put into the subarachnoid space since it became the routine myelographic contrast medium in late 1945. The patients were asked to come to the hospital where interval histories were taken and physical examinations were done to see if any signs or symptoms not expected in the course of their diseases had appeared. The patients were then examined by x-ray to see how much contrast medium remained and if it were mobile.

Results. During the period from January 1, 1946, to October 1, 1948, 106 myelograms were done with pantopaque in which up to 6 cc. of contrast medium had been allowed to remain in the subarachnoid space without attempt at aspiration. Many of these patients were either too sick to come to the hospital, lived too far away, had succumbed to their disease or could not be reached. However, twenty-five patients were able to return to the hospital for examination. As two patients had had two myelograms, there were follow-up studies on twenty-seven pantopaque injections. The duration of the follow-up interval was as follows: under six months, nine patients; six months to one year, seven patients; one to one and a half years, two patients; one and a half to two years, 5 patients; two to three years, four patients. Although severe acute reactions to pantopaque have been reported,[12] only one patient in this group had a record of any acute symptoms. These symptoms, which disappeared in two or three days, were mild low back pain and pain in the distribution of both sciatic nerves.

None of the patients seen had any signs or symptoms which could be charged to the retention of the pantopaque. It is also sig-

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nificant to note that although only 24 per cent of the total group was seen, no record could be found of readmission to the hospital for complaints which might have been caused by retention of pantopaque in the subarachnoid space.

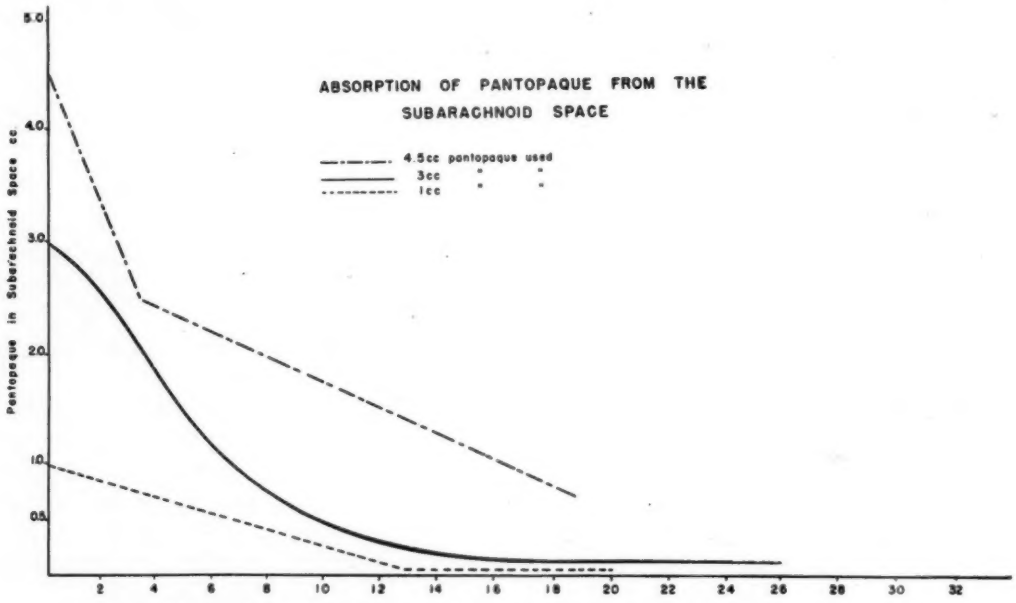

FIG. 1. Absorption of pantopaque; abscissa shows time since injection in months.

X-ray examinations were confined to the spinal subarachnoid space although it has been reported that in cases in which small amounts of pantopaque have been left in the spinal subarachnoid space it was seen in the cranial subarachnoid space in 23 to 29 per cent after a short follow-up interval.[5] It is obvious that if mobile contrast medium is left in the spinal subarachnoid space and does not get into the intracranial subarachnoid space, the patient has not had his head lower than his spine.

Fixation of a large mass of pantopaque was found in only one patient although in 55 per cent of the patients seen small drops had become fixed. This is similar to previous findings reported by Preacher and Robertson.[5] The length of time for fixation to take place varied considerably; but if the pantopaque was completely injected into the subarachnoid space, fixation of even small drops was not seen before two months after myelography. In one patient seen thirty-four months after myelography the residual pantopaque was all freely mobile.

Although no symptoms seemed to result from these fixed droplets, it must be emphasized, as Wyatt and Spurling[17] point out, this fixation does demonstrate a "clinically silent" reaction to the pantopaque in the subarachnoid space. Reaction to pantopaque has also been demonstrated by the studies of Preacher and Robertson[4] on cerebrospinal fluid changes after pantopaque myelography. The general results of the author's study are summarized in Table 1.

As previously reported,[5,17] the absorption rate of pantopaque was found to vary considerably from patient to patient. Absorption studies in this group were difficult because in many instances the amount of pantopaque originally used had not been recorded. However, when possible an estimate of this amount was made from the original films. By plotting the amount of pantopaque in the subarachnoid space against the time it had been there, rough absorption curves could be made. (Fig. 1.) It is seen that the absorption rate is greater with more material present. This datum is too crude to ascertain whether the amount of pantopaque alone is the determining factor or whether the length of time it is in the subarachnoid space is also important. Because of the crude nature of this datum, these curves should be considered only as qualitative.

No indication of the area where absorption takes place nor the mechanism by which it takes place emerged from these studies. However, it was noted that absorption continued

TABLE 1
FOLLOW-UP STUDY OF PANTOPAQUE RETENTION

Hospital No. and Patient	Diagnosis	Amount Used	Time since Myelogram	Estimated Amount of Pantopaque Remaining	Mobility of Pantopaque at Follow-up
4000 L. C.	Spastic paraplegia	.....	2 da.	No change	All mobile
9320 T. C.	Cervical trauma	.....	1 wk.	No change	All mobile
R. B.*	Postmeningitis	2.5 cc.	3 wk.	No change	All mobile
4085 M. S.	Spinal tumor	.....	6 wk.	No change	All mobile
9275 H. G.	Herniated disc	3 cc.†	2 mo.	2.5 cc.	Most mobile; few fixed droplets
10932 D. S.	Transverse myelitis	.....	3 mo.	No change	All mobile
R. G.*	Spinal vascular anomaly	4.5 cc.	3½ mo.	2.5 cc.	All mobile
9184 F. Y.	Syringomyelia	6 cc.†	4½ mo.	No change	All mobile
M. C.	Cervical neurofibroma	3 cc.†	4½ mo.	.3 cc.	Majority mobile; many fixed droplets
W. R.	Herniated disc	.....	10 mo.	.....	Not examined by x-ray
6689 H. B.	Syringomyelia	3 cc.	11 mo.	.2 cc.	All mobile
3345 B. S.	Spinal tumor	3 cc.	11 mo.	2 cc.	All mobile
6221 F. S.	Syringomyelia	3 cc†	12 mo.	1 cc.	All mobile
6508 F. W.	Angioma of cord	1 cc.	12 mo.	.5 cc.	Fixed in two large globules
6366 L. A.	Spinal meningioma	1 cc.	12 mo.	.2 cc.	½ mobile; ½ in one large globule
5867 T. L.	Paraplegia, late onset	3 cc.	12 mo.	2.75 cc.	All mobile
4475 B. D.	Herniated disc	1 cc.	16 mo.	0.75 cc.	All mobile
241 J. T.	Herniated disc	3. cc.	17 mo.	.3 cc.	All mobile
2316 A. F.	Paraplegia, late onset	4.5 cc.	19 mo.	0.75 cc.	Few fixed droplets; mostly mobile
2605 A. N.	Spinal cord neurofibroma	3 cc.	20 mo.	Partly removed at operation; 0.1 cc.	Few fixed droplets; mostly mobile
2127 D. H.	Spinal cord neurofibroma	2 cc.	20 mo.	0.3 cc.	Few fixed droplets; mostly mobile
687 W. W.	Spinal cord neurofibroma	.....	22 mo.	1 cc.	All freely movable
E. W.	Spinal tumor	.....	23 mo.	.2 cc.	Scattered fixed droplets
R. B.*	Postmeningitis	3.5 cc.	26 mo.	.2 cc.‡	Scattered fixed droplets
A. E.	Spinal tumor	.....	28 mo.	.1 cc.	Scattered fixed droplets
R. C.*	Spinal vascular anomaly	2.5 cc.	34 mo.	.1 cc.	Mobile
2057 M. M.	.....	.....	36 mo.	.1 cc.	Fixed in few small droplets

* Had two myelograms 26 mo. apart. Regarding the symptoms referable to myclogram and/or pantopaque retention, patient R. C. had pain in low back, sciatic nerves for 2 da.

† Amount estimated from first films as actual amount not recorded.

‡ Some said to have escaped at operation; described in operative note as "a few drops."

in the fixed droplets as well as in the mobile portions of retained pantopaque. As Wyatt and Spurling[17] point out, when absorption does take place the shadow does not gradually fade away as if opacity were being lost but rather the shadow diminishes in size as if the material were being completely removed.

Two of the patients re-examined had had two myelograms. In both cases pantopaque had been used in the first myelogram some two years prior to the second; but as most of the pantopaque had been absorbed, a second injection of pantopaque was required for adequate myelography. There were no untoward symptoms observed as a result of the second myelograms which at this writing had been followed up for three weeks and three and a half months.

Acknowledgment: Thanks are given to Dr. E. A. Carmichael for making this study possible and Dr. H. Davies for his help and free use of the files of the x-ray department. Also, thanks are given the other members of the staff of The National Hospital for allowing the author to examine their patients.

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FEVER IN CARCINOMA OF THE COLON AND RECTUM

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FEVER has long been recognized as a sign of carcinoma. This fact receives little attention in those papers which are concerned with the diagnosis of malignancy in the colon and rectum. However, fever is often manifested by these patients, and it can be the only finding to indicate the presence of a pathologic disorder. Fever accompanies carcinoma of the colon and rectum in a much higher percentage of patients than was found in a general study of fever due to carcinoma whose origin was not specifically considered. In this series 70.3 per cent of the patients had an otherwise unexplained fever some time during the preoperative period. Fever was found in patients whose lesions were described as ulcerating and fungating, but was not found when the lesions were described as small and non-ulcerated. In order to rule out neoplasms of the rectum and colon, a complete physical examination of the region must be made. This is to be followed by an adequate barium enema and air contrast studies, as well as laboratory examinations, before a decision can be reached. Unexplained fever is an indication for complete colon and rectal studies and may be the only sign or symptom of the pathologic condition which exists. In a series of sixty-four patients 4.9 per cent had no other findings or symptoms than fever to indicate that carcinoma was present in the rectum or colon.

* * * *

Briggs[1] pointed out that prior to modern times fever was stressed as a sign of carcinoma. He made a study of fevers in 238 cases of carcinoma originating from various sites. He concluded that although it was not a predominant symptom of the disease, fever could be expected to occur at some time during the course of the disease in over one-third of the patients. He stated, also, that metastases had little to do with the presence of fever.

Fever due to carcinoma of the gastrointestinal tract is mentioned by various authors[2,3] in discussions of fever of obscure and undetermined origins. Bacon[4] mentions it in discussing complications of carcinoma in the rectum and colon. Little can be said as to the mechanism of the production of fever in these cases. Bacon[4] related the cause to secondary infection, especially in ulcerated lesions, and states that this can account for fevers otherwise undiagnosed. Because of constant contamination of a lesion in this area, infection certainly will be a large factor in fever production. Horan[5] pointed out that toxic degeneration may be the cause of fever in carcinoma, but frequently there is no evidence of necrosis to explain the fever.

Although the mechanism is open to conjecture, the fact that fever does often exist in these patients cannot be doubted. Recognition of this fact should lead to an earlier search for cancer than might otherwise be made.

It is universally agreed that in order to improve results in patients with carcinoma of the colon and rectum, the time interval between the onset of symptoms and the institution of proper therapy must be cut down.[6–8] Earlier diagnosis is one of the factors which can reduce both mortality and morbidity from this disease. The need for additional signs to indicate malignancy of this region is shown when one considers that some patients do not complain of the usual signs and symptoms found in carcinoma of this region. In a series of 300 cases Swinton[9] stated that 2.3 per cent of the patients studied did not have the ordinary indications of rectal or colon malignancy. In the series presented here 9.3 per cent did not have any symptoms referable to the distal portion of the gastrointestinal tract.

In a twelve-month period from August 1, 1948, to July 31, 1949, sixty-four patients with clinical carcinoma of the rectum or colon were seen in Milwaukee County General Hospital. In three of these patients persistent, obscure fever was the only finding which led to an examination of the rectum and colon, with a subsequent discovery of the pathologic disorder. This is 4.9 per cent of the total series. Of these sixty-four consecutive patients seen, fifty-seven had lesions described as ulcerating

and fungating. Most of them were described as bleeding. The remaining seven lesions had no gross evidence of ulceration. Two of the seven patients with non-ulcerated lesions had fevers, one of which could be accounted for by an upper respiratory infection. Of the fifty-seven patients with ulcerated lesions, five had no fever during their preoperative period; the other fifty-two had fever during some part of that period. Other diseases or dehydration accounted for fever in seven of these fifty-two, but there were forty-seven or 70.3 per cent of the sixty-four patients with carcinoma in which the fever could not otherwise be explained.

This study included only clinically malignant lesions of the colon and rectum. A survey of patients with small non-ulcerated carcinomas showed that they had no elevation of temperature due to their lesions.

COMMENTS

The foregoing analysis of statistics indicates that fever will be found in a large percentage of patients who have a malignant lesion in the colon or rectum. Because of this, a complete examination of the anus, rectum and colon is indicated in the search for the cause of obscure fever. A barium enema is not sufficient to rule out pathologic disorders in this area.[10]

An adequate examination includes the following: (1) complete proctosigmoidoscopic examination, (2) barium enema, followed by air contrast examination, if necessary and (3) laboratory work.

On proctosigmoidoscopic examination about 70 per cent of all neoplastic pathologic disorders of the colon and rectum can be found. This is not a difficult examination in the hands of an experienced operator, and it should be done early as part of the initial physical examination. Sigmoidoscopic examination should precede barium studies of the colon.[11]

Barium enema examination and air contrast studies can be relied upon to reveal most of the neoplasms present in the remainder of the colon. These studies must be repeated until the roentgenologist and clinician are satisfied that a demonstrable pathologic condition does not exist.

Laboratory examinations are helpful. A hypochromic, microcytic anemia is often found accompanying carcinoma of the right side of the colon. Increased sedimentation rates are found in many patients who have carcinoma. Stool examination will reveal gross, microscopic or chemical evidence of bleeding. The finding of red and white cells in the stool is indicative of pathologic disorder but not necessarily malignancy.[12] Recent work has indicated the importance of cytologic studies of rectal mucus for malignant cells. By using this method Wisseman,[13] was able to diagnose the presence of a malignant lesion which had previously been missed by physical and roentgenologic examination. Studies now being conducted at this hospital confirm the usefulness of this method of diagnosing malignancy of the distal portions of the colon and rectum.[14]

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FEMORAL SHORTENING IN SUBTROCHANTERIC REGION COMBINED WITH ANGULATION AT SITE OF RESECTION

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A METHOD of femoral shortening by resection of bone from the subtrochanteric region to equalize lower extremity length discrepancies is described. When there is painful hip associated with the longer extremity, a Schanz type of operation can be combined with the shortening operation. A blade plate will maintain the position without any external fixation in either type of operation.

* * * *

Femoral shortening to equalize discrepancy in length of the lower extremities after growth is completed is in most cases the preferable type of operation. The operation is not to be undertaken without due consideration of the hazards and the possibilities of an adverse result in case of infection, injury to nerves and blood vessels and disturbance in function of the muscles or joints in the normal extremity. Fortunately, with careful technic these mishaps are rare and the results are so good that it is a justifiable procedure.

The majority of shortening operations have been performed in the middle or lower third of the femur by a step type or diagonal osteotomy, the fragments being held by pins, wires or plates or allowed to slide by each other without internal fixation. A plaster spica is applied on completion of the operation.

For a number of years the writer has been performing the shortening operation with a resection in the subtrochanteric region of the femur. It is believed that osteogenesis is more active in that portion of the femur with resulting earlier union. There is also less chance of injury to the nerves and blood vessels and should a malalignment take place there would be less deformity or hinderance in function. In some patients there has been, in addition to the disturbance in function due to a short extremity, a painful hip joint on the longer side or at both hip joints. In some of these painful hips a shift or change in the weight-bearing surface of the femoral head by the method of Schanz will relieve the painful symptoms. In these particular cases in addition to the shortening an angulation is purposefully made at the site of resection. As in the primary shortening operation, there are some important steps to be observed.

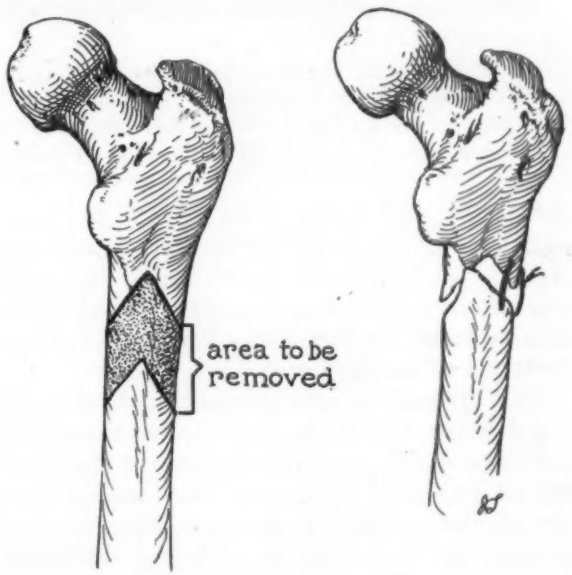

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FIG. 1. Diagram to show the method of resection with chevron-shaped cuts.
FIG. 2. Diagram; ends of resected bone brought together; distal fragment wedged into the cancellous bone of proximal fragment and held with one wire suture.

METHOD OF SIMPLE SHORTENING OF FEMUR IN SUBTROCHANTERIC REGION

A lateral incision is made on the side of the selected femur beginning just above the greater trochanter and extending down about 6 inches. After passing through the fat and fascia the origin of the vastus lateralis muscle is exposed. The muscle may be peeled off the shaft or split and dissected off the femoral shaft. The periosteum is then incised longitudinally along the exposed femur and peeled off around the entire circumference. The desired length of bone to be removed is marked on the cortex,

3 4

FIG. 3. Patient B. M.; shows the position of fragments after 2½ inches of shortening in the subtrochanteric region with angulation at the site of resection. The fragments were maintained in position without external fixation by using a Moore-Blount gooseneck type of plate.

FIG. 4. Patient H. W.; shows the position of the fragments after shortening and angulation. The position was maintained by the plate without external fixation and healing is firm.

the upper end being close to the proximal expansion of the femur in the subtrochanteric region. Two drill holes are made at the upper and two at the lower end to serve as guides for alignment or for insertion of pins at the termination of the operation.

Two chevron-shaped cuts are made through the anterior half of the cortex with the motor saw, one at the upper end and one at the lower end of the piece of bone to be removed from femur. The posterior upper half of the chevron-shaped cut is completed with the osteotome aided with a few drill holes through the cortex. The upper end of the distal fragment is delivered into the wound. The remainder of the posterior half is removed leaving a small pointed piece of bone on the distal surface of bone. The two adjacent ends are approximated and the pointed portion of the distal fragment is forced into the cancellous bone of the proximal fragment. A wire is passed through two drill holes previously made and the ends twisted upon each other. If the wire is not used, there is a tendency for the fragments to displace as the muscles are slack after the resection. As there is little tension, one wire is sufficient to hold them together. To prevent any rotation of the short upper fragment a nail is inserted into the trochanter and neck. (Fig. 1.) This is allowed to project out of the incision which is closed in layers. The pin is incorporated in the plaster spica and allowed to remain in place for three or four weeks. It is advisable to take a roentgenogram before removal of the pin as any change in alignment may be better accomplished by wedging the plaster with the pin in place. The roentgenogram (Fig. 2) shows the healing.

METHOD FOR SHORTENING AND SIMULTANEOUSLY PRODUCING ANGULATION AT SITE OF RESECTION

The same type and method of resection of the subtrochanteric piece of femur is performed up to the time of approximating the two resected ends of bone. Instead of forcing the pointed piece of bone of the lower fragment into the upper end in direct alignment, it is inserted so that the two fragments form an angle to give the desired change in thrust of the shaft on the head of the femur. The procedure as carried out on two patients is reported as follows to show the indications and results:

Patient B. M., aged twenty-five years, was seen in 1945 complaining of pain in the right hip. Roentgenogram revealed an old congenital dislocation of the right hip joint with only a remnant of a malformed head. The left femoral head was luxated and less malformed than the right. The right lower extremity was over 4 inches longer than the left in spite of its higher position. This was due in part to developmental changes in the left extremity and in part to the adducted position of the

right extremity. The resection of the femur was performed removing 2½ inches from the subtrochanteric region. In fitting the two ends together the lower fragment was placed so that there was about 40 degrees angulation at the site of the approximation of the two ends of the bone.

A Blount blade angle plate was then fitted and applied to maintain the position of the two fragments of bone. No external type of fixation was utilized. Healing was uneventful and the position of the fragments was maintained by the plate. (Fig. 3.)

The second patient, age thirty-four years, had bilateral dislocations at the hip joints. At the age of eleven years the right hip was reduced by close manipulation. The left was not treated. When she was about thirty-two years of age, her right hip became painful and steadily got worse. Then the left hip became painful; this pain increased so that she was unable to walk without severe pain. Conservative treatment did not give her any relief.

It was then decided to perform a Schanz type of osteotomy on the right hip. As the right extremity was about 4½ inches longer than the left lower extremity, it was thought advisable to shorten the femur at the same time the osteotomy was performed. The same procedure was carried out as in the previous patient. The fragments after the resection were angulated at about 35 degrees and held in place with the Blount goose-neck type of plate. Again no external fixation was utilized. The fragments maintained their position until healing was complete. (Fig. 4.) The painful left hip was treated using obturator neurectomy. The patient also had a severe genu recurvatum that was improved with a Bruce Gill operation. She was relieved entirely of her painful symptoms and her gait was markedly improved by the operations.

Practical Surgical Suggestions

SURGICAL APPROACH TO UPPER ABDOMEN THROUGH INCISION PARALLELING THE COSTAL MARGIN WITH EXCISION OF COSTAL CARTILAGE OPPOSITE THE FIFTH INTERCOSTAL SPACE

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INCISIONS through the costal margin, once considered hazardous largely because of possible infection, are now commonplace. Division of the left costal margin at the eighth interspace for exposure of the lower esophagus and stomach has contributed greatly to the ease with which gastro-esophageal resections may be done.[1–6] On the right, the combined abdominothoracic incision through the eighth or ninth interspace is now used generally to expose the subhepatic area for establishing portavenacaval shunts as described by Blakemore.[7]

A logical development was to apply this combined abdominothoracic incision through the seventh or sixth interspace for exposure of the common duct either for its reconstruction or for the removal of stones. (Fig. 1*a*.) In the presence of a large bile-filled liver this incision gave a direct and more satisfactory approach for locating and isolating the remnants of the divided common duct.

Recently, however, the conventional subcostal incision for cholecystectomy has been modified so as to provide an improved exposure of the subhepatic area. (Fig. 1*b*.) The incision is made 2 cm. below and parallel to the mid-costal margin. Without following the normal curve of the costal margin the incision is continued straight to the midline where skin and linea alba are incised vertically to the xiphisternum. This simple division of the linea alba for 3 to 4 cm. permits lateral displacement of the costal margin and a surprisingly improved exposure of the common duct. Moreover, should additional exposure be deemed necessary, as in reconstruction of the common duct, the incision in the skin is continued upward over the mid-sternum for 4 to 5 cm. and the lateral edge of the incision is elevated and displaced laterally to permit excision of the costal cartilage opposite the fifth interspace. This provides for even greater lateral retraction of the costal margin, greater displacement and rotation of the underlying liver, and a correspondingly more direct approach to the common duct.

Following this satisfactory experience in exposing the common duct the same approach was modified and extended to expose the portal vein and vena cava in portal hypertension. The combined abdominothoracic incision through the eighth or ninth interspace although usually satisfactory has proved on occasion quite inadequate in the presence of the large low-lying liver. Accordingly, for portavenacaval anastomosis the following approach is now invariably employed and is recommended as the incision of choice. (Figs. 2, 3 and 4.)

The usual incision 2 cm. below and parallel to the mid-costal margin is continued laterally and vertically downward in the anterior axillary line for about 4 cm. to a point opposite the umbilicus. Medially it runs directly to the midline, vertically upward through skin and linea alba for about 4 cm. and then through the skin over the mid-sternum for another 4 to 5 cm. The upper third of the lateral skin edge is displaced laterally by sharp dissection to expose the fused costal cartilage of the sixth and seventh ribs opposite the fifth interspace. About 2 cm. of this costal cartilage are removed subperichondrally. The tissues posterior to the cartilage are incised from the linea alba laterally into the fifth interspace dividing the posterior

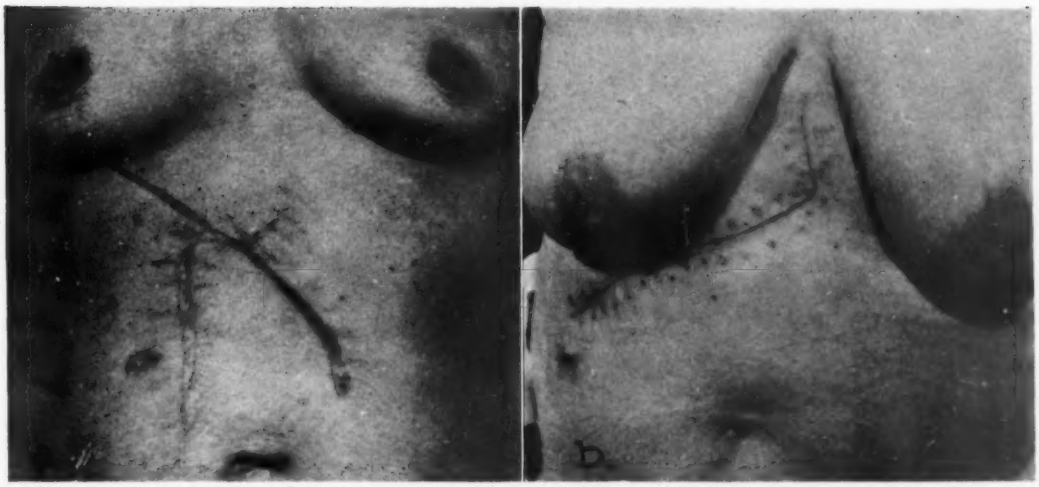

FIG. 1. *a*, Combined thoracico-abdominal incision on right provided excellent exposure for reconstruction of common duct. *b*, Recommended incision for cholecystectomy lies 2 cm. below and parallel to mid-costal margin, runs to midline and is continued vertically through linea alba to xiphisternum.

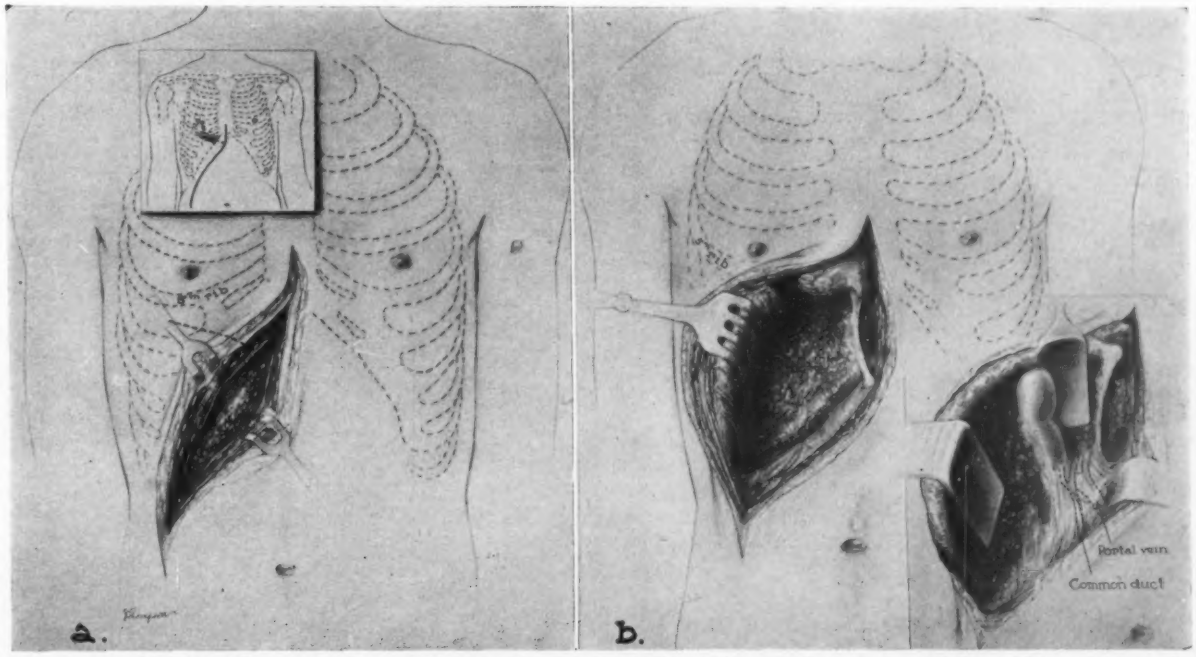

FIG. 2. *a* and *b*, Excellent exposure of portal vein area is obtained through incision parallel to mid-costal margin with vertical component at either end and division of fused costal cartilages opposite the fifth interspace.

perichondrium, the intercostal muscles and occasionally the diaphragm. The length of this laterally directed incision in the fifth interspace varies from 4 to 6 cm. depending upon the degree of lateral displacement of the costal margin that is required to give adequate exposure. It may or may not be necessary to enter the thoracic cavity but the anesthetist is prepared for this eventuality by intratracheal intubation.

As a result of these incisions the costal margin is easily displaced laterally and upward for several centimeters, uncovering the underlying liver. The round ligament is divided and the liver is displaced and rotated upward and laterally, providing direct and easy access to

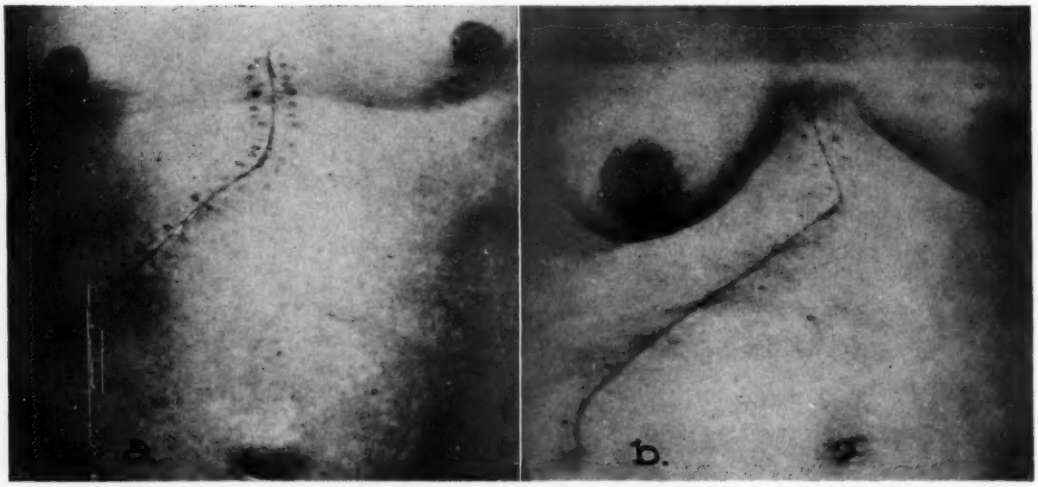

FIG. 3. *a*, In a heavy man of sixty-five a portavenacaval anastomosis was easily performed through subcostal incision. (Fig. 2.) *b*, In a forty-nine year old woman complete division of portal vein and end-to-side anastomosis to vena cava was performed easily through subcostal incision. (Fig. 2.)

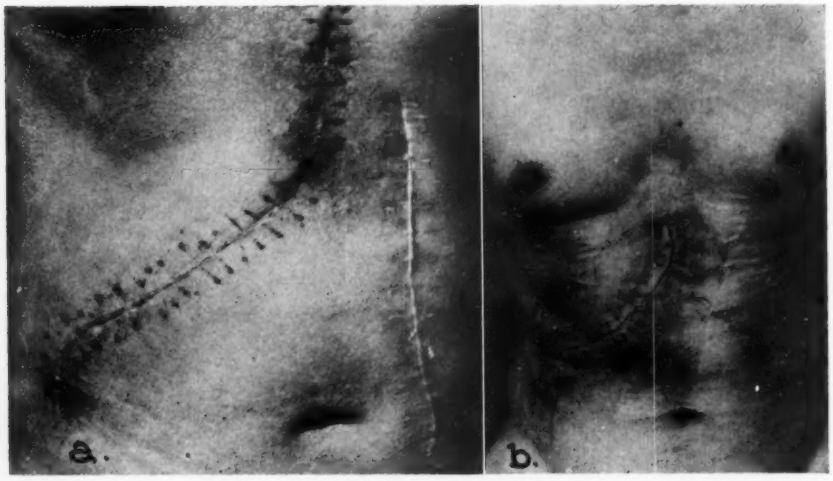

FIG. 4. *a*, In a nineteen year old Chinese-American a previous splenectomy was supplemented by an end-to-side portacaval anastomosis through subcostal incision. (Fig. 2.) *b*, Appearance of wound in a twenty-six year old Japanese-American seven days after portacaval anastomosis for recurring hemorrhage.

the common duct, portal vein and vena cava. It is this delivery and rotation of the liver made possible by the mobilization of the costal margin and division of the round ligament that makes this anterior and medial approach to the portal vein so much more satisfactory and direct than the more lateral approach through the combined abdominothoracic incision.

On the left the exact counterpart of this incision paralleling the left mid-costal margin with excision of the costal cartilage opposite the fifth or sixth interspace has been used advantageously for splenectomy and splenorenal anastomosis in portal hypertension. (Fig. 5.) It should also be particularly helpful for exposure and repair of a diaphragmatic hernia.

When gastric resection and vagotomy for duodenal ulcer are contemplated, the usual midline incision from umbilicus to xiphisternum is supplemented by excision of the costal cartilage opposite the left fifth interspace and by extension laterally of the midline incision into the left fifth interspace for 3 to 4 cm.

FIG. 5. *a*, In this five year old boy with congenital absence of portal vein an anastomosis was effected between a 5 mm. pancreatic-duodenal vein and the vena cava through a combined thoracico-abdominal incision (I). *b*, Because of recurring hemorrhages a splenectomy and splenorenal anastomosis was performed through a left subcostal incision and division of costal cartilage opposite the sixth interspace (II).

without, however, entering the thoracic cavity. This oblique lateral extension of the midline incision into the left fifth interspace provides a direct access to the lower esophagus that is a great boon when identification of such an elusive structure as the vagus nerve is necessary or when a high gastric resection is contemplated.[8]

In using incisions requiring the excision of costal cartilage several precautions should be stressed: Care must be taken to cut away all cartilage that has been exposed and denuded of its perichondrium in order not to leave behind an avascular cartilage which might be an easy prey to infection. Another precaution against infection is to moisten the tissues repeatedly during closure with a solution containing 200,000 units of penicillin and 1 gm. of streptomycin.

Great care is taken also to reapproximate accurately the previously divided soft tissue layers, preferably by interrupted sutures of doubled medium (No. 000 Deknatel) silk. In reapproximating fascia, particularly the linea alba, the end-on mattress suture of silk ("big bite, little bite, little bite, big bite") is considered invaluable in that it insures accurate coaptation of the divided fascial edges. If this is neglected and the fascial edge lies against fat instead of the opposite fascial edge, poor healing and wound disruption are more likely to occur. If soft tissues are accurately coapted, there is no need to reapproximate the divided cartilage. Enough cartilage is removed so that the two raw surfaces do not rub together during respiration. Avoidance of infection and accurate reapproximation of the divided soft tissues are of prime importance when employing these new approaches that involve division and excision of the costal cartilage.

SUMMARY

Incisions paralleling the mid-costal margin combined with a vertical incision of the linea

alba, with excision of the costal cartilage opposite the fifth interspace and with a short laterally directed incision in all tissues of the fifth interspace except the skin, provide an excellent approach on the right to the common duct, portal vein and vena cava, and on the left to the cardia, abdominal esophagus, spleen and left kidney. This approach on the right is recommended in repair of a divided common duct and in portavenacaval anastomosis, and on the left in splenectomy, splenorenal anastomosis and possibly in the repair of diaphragmatic hernia. For gastric resection the midline incision from umbilicus to xiphisternum is preferred, to be supplemented by excision of the costal cartilage opposite the left fifth interspace to facilitate vagus section or high gastric resection. For simple cholecystectomy the subcostal incision paralleling the mid-costal margin to the midline and continued vertically upward through the linea alba to the xiphisternum provides improved exposure of the subhepatic area. In a difficult choledochostomy division of the costal cartilage opposite the fifth interspace may be utilized when indicated for better exposure.

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CHOLEDOCHOSTOMY—A SIMPLE DEVICE FOR COLLECTING BILE

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COMMONLY used methods of collecting bile from a T tube in the common bile duct are: (1) The T tube is extended by rubber tubing into a drainage bottle fixed to the bed or allowed to rest on the floor beside the bed. (2) A bottle with a rubber stopper is fixed to the patient's dressing or abdominal binder.[1] The first method does not allow for mobility of the patient. The second method has the following disadvantages: It spills easily with motion of the patient causing soiling of dressings, the patient's clothing and bed linen. The bottle has to be removed several times a day in order to measure contents and avoid overflow. Frequent removal of the bottle is occasionally associated with dislodgment of the T tube, particularly when the precaution of fixing the tube to the skin at operation has not been taken. Glass bottles commonly used are heavy and cumbersome.

To overcome these deficiencies a bottle has been constructed which has proved useful. (Figs. 1 and 2.) It consists of a square, 6 ounce, translucent plastic bottle, graduated in ounces, with a rubber tubing outlet which is easily opened or closed by an ordinary screw clamp. The mouth of the bottle is covered with a piece of rubber dam and then capped with a No. 150 Davol bottle cap which has been perforated to accommodate a T tube up to size 32 French. A slit is made in the rubber dam to permit entry of the tube into the bottle. An additional

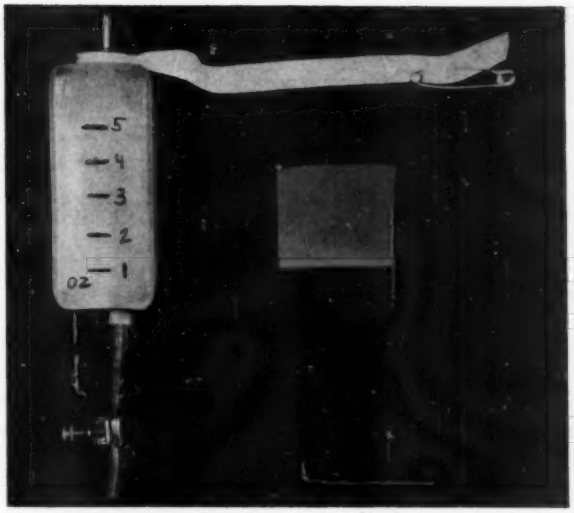

FIG. 1. The bottle and a piece of rubber dam. (The rubber seal which comes with commonly used infusion bottles may be substituted for the rubber dam.)

pin point opening is made besides the slit to permit escape of displaced air. Gauze bandage or ¼ inch umbilical tape is tied around the neck of the bottle and fixed to the binder with a safety pin, allowing for slack in the catheter. This device* has the following advantages: (1) It is light in weight. (2) Bile can be measured and emptied easily; by the third or fourth postoperative day the patient often does this himself. (3) Should the bottle tip, there is little spill through the air vent. (4) The rubber dam with slit for the tube acts as a valve preventing

* Produced by Clay Adams Company, Inc., New York, N. Y.

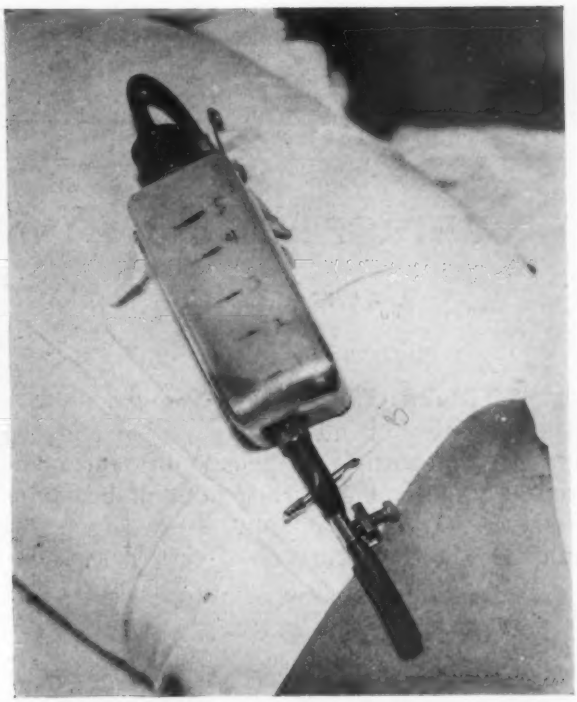

FIG. 2. The bottle in use. (The bakelite cap has been replaced by a Davol bottle cap over rubber dam.)

gross bile leak, yet it does not hold the unsecured catheter so tightly that it may be dislodged because of the weight of a filled bottle.

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Case Reports

RETROPERITONEAL CAVERNOUS HEMANGIOMA*

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RETROPERITONEAL hemangiomas are rare but must be considered in the differential diagnosis of retroperitoneal tumors. The pathogenesis of hemangiomas is still undetermined. A developmental anomaly in the structure of certain vascular segments may be responsible for this lesion. Matas,[1] and Delafield and Prudden[2] maintain that hemangiomas are composed of the same cellular elements that give rise to primordial blood vessels. In accordance with this they believe that the hemangioma is the result of disordered, spontaneous growth of these primitive cells. Why hemangiomas assume a capillary or cavernous configuration and why they occur at all is imperfectly understood. An angioma is considered a true neoplastic process involving vascular and/or lymphatic tissue. It is generally believed that angiomas are congenital in nature and have their origin in misplaced mesodermal tissue.

FIG. 1. Picture taken prior to operation.

In the literature extrarenal retroperitoneal hemangiomas are found to be very rare. Hilse[3] in 1928 reported a large recurring retroperitoneal lipoma that had areas of cavernous hemangioma in it. In 1929 Harris[4] reported the case of a fifty-nine year old white male who had an encapsulated retroperitoneal perirenal fibrohemangioma about the size of a grapefruit. The lesion was removed but the patient died eleven days postoperatively probably from a cerebral embolism. A retroperitoneal pelvic hemangioma was reported by Frank[5] in 1930. The patient was a thirty-five year old unmarried female admitted to Mt. Sinai Hospital because of abdominal pain of four hours' duration. A hemangioma was removed from the left broad ligament six years previously. Operation at this time revealed a large hemangioma of the pelvic floor, which surrounded the uterus and extended on to the urinary bladder and sigmoid. The author states that with much difficulty this retroperitoneal cavernous hemangioma was removed along with the uterus and that convalescence was uneventful. Two years later the patient was reoperated upon and recurrence noted. Removal of the lesion was impossible at this time. Radium, 19,250 mg. hours, was applied per vagina and over the abdomen and buttock (treatment factors not known).

Tapfer and Just[6] in 1935 reported a case of capillary hemangioma of the connective tissue of the pelvis. In 1944 Millman[7] reported a retroperitoneal cavernous hemangioma in a white male thirty-two years of age who had a large, non-tender, smooth mass in the right lower quadrant. The cecum and ascending colon were displaced to the midline. At operation a cavernous hemangioma about the size of a pineapple lying on the right ileopsoas muscle was encountered. The tumor which was moderately adherent to the retroperitoneal tissues was removed.

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FIG. 2. Anterior surface of the bladder.
FIG. 3. Photograph showing posterior wall of bladder (A) hydro-ureter, left (B) and hemangioma on anterior surface of sigmoid (C).

FIG. 4. Photograph showing hemorrhagic areas beneath the mucosa of sigmoid.

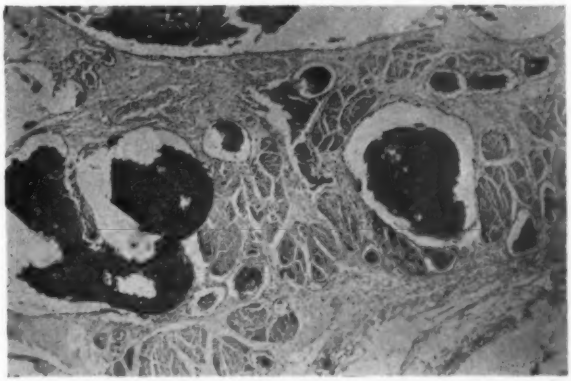

FIG. 5. Photomicrograph of hemangioma of bladder wall.

The purpose of this paper is to report a case of a retroperitoneal cavernous hemangioma which was a complicating factor to what appeared to be a subcutaneous plexiform hemangioma of the buttocks.

CASE REPORT

The patient, a white male, was first seen at the age of five months because of rectal bleeding and two hemangiomas, one overlying the right buttock and the other over the mid-sacral crest. The hemangioma of the sacral crest measured 2 by 1 cm.; the one of the right buttock which extended beyond the midline in the intergluteal fold measured 8½ by 6 cm. (Fig. 1.) The smaller hemangioma was treated with radium on February 5, 1946 (120 mg. hours (2 T.E.D.), filtration 1 mm. pt., S.T.D. 0.5 cm.). Rectal and proctoscopic examinations were normal. On February 22, 1946, the child received 340 r over the large hemangioma (technic 140 kilovolt, 15 milliampere, filtration none, S.T.D. 35 cm., field size 4 cm.). On March 22, 1946, x-ray examination of pelvis revealed the pelvic bones to be normal in density, and a soft tissue mass lying posterior to the coccyx was noted. On March 27, 1946, and September 16, 1946, the child received 408 r over the large hemangioma using the same technic as previously described, making a total of 1,156 r. During this time the hemangiomas were paler and only occasionally was rectal bleeding noted. Barium enema on May 20, 1947, was essentially normal; but because satisfactory regression of these lesions was not forthcoming and intermittent rectal bleeding still persisted, operative intervention was deemed advisable. On July 20, 1947, the patient was admitted to the University Hospital for surgery.

On July 21, 1947, under ether anesthesia an attempt was made to remove the hemangiomas. In the subcutaneous tissue overlying the buttock many large veins and venous sinuses were encountered and excised. The hemangiomas were connected by large veins. The larger

hemangioma was made up of sinuses, some containing blood and others clear fluid. The dissection was carried to the right of the coccyx and it was obvious that the lesion extended into the pelvic floor. At this point the child had what was thought to be an ether convulsion, and responded well to oxygen. Sylnasol, 6 cc., was injected into the largest sinus to the right of the coccyx with the hope of obliterating this retroperitoneal extension. The wound was closed with interrupted dermal sutures. About one hour following operation hyperpyrexia and clonic convulsions developed. It was thought that the patient's symptoms could be explained on the basis of cerebral anoxemia. The child continued to remain comatose. Finally decerebrate rigidity developed and on August 24, 1947, respirations ceased.

At autopsy a large retroperitoneal cavernous hemangioma of the pelvic floor was found to be continuous with the excised lesion. From the pelvic floor the lesion surrounded the neck of the urinary bladder and extended over the posterior wall and fundus of the bladder. (Figs. 2 and 3.) The lesion surrounded the ureterovesical junction to cause bilateral hydro-ureters. A small ramification extended beneath the peritoneal covering of the sigmoid. (Fig. 3.) On opening the sigmoid small punctate hemorrhagic spaces were found beneath the mucosa. (Fig. 4.) This probably accounts for the patient's rectal bleeding. Careful examination revealed venous communications between the iliac veins and the previously described tumor mass. Dilated retroperitoneal pelvic lymphatics were noted and thought to be due to a lymphatic blockage caused by this retroperitoneal hemangioma. An attempt at autopsy to remove this lesion was impossible. Microscopic examination revealed a cavernous hemangioma. (Fig. 5.)

The brain showed diffuse encephalomalacia of the cerebral cortex, pons and cerebellum (post anoxic), cerebral congestion and edema.

CONCLUSIONS

Retroperitoneal hemangiomas are rare but should be considered in the differential diagnosis of retroperitoneal tumors. Diagnosis as well as therapy is difficult. Complete extirpation should be performed whenever possible. Use of x-ray and radium is an important adjunct in the treatment but, because of the inaccessible location, it has little value in curing the lesion. This case should bring to mind the importance of rectal bleeding in association with hemangioma in the perineal area as well as the futility in treating such extensive lesions.

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PRIMARY SARCOMA OF THE GALLBLADDER

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JAFFEE[4] in 1918 stated that only twelve cases of primary sarcoma of the gallbladder had been described, if doubtful cases were excluded. In 1937 Dyrenforth and Jelks[3] found thirty-four cases in a review of the literature through 1935. Adding the reports of Büttner,[2] Raquis[7] (two cases), Osterlin and Mendelson,[6] Sammartino,[8] Schmidt[9] and Lindenbaum[5] gives us a total of forty-one cases of primary sarcoma of the gallbladder to 1948. The condition is rare; however, many cases probably go unrecorded because a biopsy is not taken when on exploration an inoperable tumor mass is found arising from the gallbladder, and a gross diagnosis of carcinoma made.

The majority of cases have been in women between fifty and sixty years of age and the greater number have also had gallstones. In the reported cases pain, jaundice, mass, weight loss or "stomach trouble" brought the patient to the physician. Metastases occur very early and Jaffee's quotation from Payers, made in 1918, is still appropriate: "no operative cure has yet been obtained in gallbladder sarcoma." As a matter of fact, there is as yet no way to make a preoperative diagnosis of sarcoma of the gallbladder.

CASE REPORT

A forty-one year old, single, white female was admitted to the Medical Service at Bon Secours Hospital, Baltimore, Maryland, complaining of jaundice and vomiting. The jaundice had gradually increased over a period of three weeks. There were clay colored stools and very dark urine. The patient stated that she had no pain but that there was intermittent epigastric fullness. The vomiting became persistent prior to hospitalization and the patient began to have a slight fever. The past and family histories were non-contributory. Menses began at eleven years, were grossly irregular and ceased when the patient was fifteen. There was no flow or discharge until one week prior to admission when the patient noted mild bright red staining for two days.

Examination revealed a well developed, obese, markedly jaundiced female. The patient's temperature on admission was 99°F., pulse 90 and respirations 20. The skin and scleras were markedly icteric. The heart and lungs were normal. A very evident abdominal panniculus was noted. The liver edge was felt four fingers below the costal margin; it was smooth and non-tender. A solid mass in the left upper quadrant was tentatively identified as a spleen enlarged about three times. There was no spasm or rigidity. The external genitalia were normal. A virginal outlet was noted and vaginal examination was not accomplished. No unusual tenderness or abnormal masses were found on rectal examination. There was slight ankle edema present. The reflexes were physiologic. A plain film of the upper abdomen revealed no pathologic condition in the gallbladder area. The blood picture was within usual limits; the Kahn test was negative and the blood sugar and non-protein nitrogen were normal. The urine showed 1+ albumin. The total protein was 5.3 with an A/G ratio of .76. The Van den Bergh test was a direct positive, bilirubin 20 mg. per cent, icteric index 125, sedimentation rate 57 mm. per hour and prothrombin 28.

A working diagnosis of infectious hepatitis was made. Intensive treatment with amigen, glucose, vitamin B and choline dihydrogen citrate was started, and the patient showed considerable improvement for one week. The nausea and vomiting continued, however, so that x-ray studies of the gastrointestinal tract could not be made. A paracentesis was done when ascites was noted and a small amount of fluid obtained. On repeated examination an irregular mid-epigastric mass was discovered. It seemed more pronounced on rechecking and the liver edge was found at the level of the umbilicus. The mass itself was non-tender except on deep pressure, roughly globular, about 6 cm. in diameter, and extended somewhat to the left of the midline.

Exploratory laparotomy was decided on,

with a tentative diagnosis of carcinoma of the head of the pancreas. Metastatic ovarian tumor, carcinoma of bile ducts and carcinoma of the gallbladder were also considered. Preoperatively, blood, protein, glucose and vitamin K were given. The patient's condition was considered fair on the morning of operation, and the exploration was carried out under gas-oxygen-ether anesthesia.

A long left paramedian incision was made. About 2 L. of pinkish yellow ascitic fluid were evacuated by suction. The uterus and ovaries were palpated and found to be normal. No masses were noted in the bowel. The liver extended to the umbilicus on the right, the surface being perfectly smooth. The left lobe was palpable far over in the left upper quadrant. The mid-epigastric mass was exposed and found to originate from the position of the gallbladder. It was grossly spherical, about 10 cm. in diameter, cystic and loculated. A trocar was inserted at three different sites yielding thick, concentrated bile. On palpation locules were outlined and papillary, necrotic material felt within the cavities. The inferior portion of the mass was much thinner and many large stones were felt. The whole mass was gradually freed and removed. With removal dozens of stones were evacuated. A solid mass was revealed the size of a fist on the underside of the right lobe of the liver bordering on the gallbladder bed. This was removed. A large mass could then be outlined in the position of the ducts extending behind the duodenum and incorporating the pancreas. The mass was solid, irregular and over 15 cm. in diameter. Bleeding was completely controlled, hemostatic gauze being used in the gallbladder fossa, and rapid closure then done. Blood, glucose and stimulants had been given during the operation. These were repeated postoperatively but the patient continued a downhill course, expiring one day after operation.

The pathologic report revealed the following: Grossly, the mass was over 15 cm., almost filled with soft, friable, semi-cystic, yellow-red tissue with fresh interstitial hemorrhage. Cystic degeneration was noted throughout the cut surface of the gallbladder which was replaced with soft, friable material and did not contain lumen. At one end of the organ a large number of irregular facetted stones were found, measuring 0.7 cm. in diameter. No definite mucosal surface could be made out. Microscopically, sections from the gallbladder showed complete distortion, replacement and destruction of the usual architecture by a very cellular anaplastic neoplasm of the mesoblastic group. It was composed of large, long, bipolar cells which showed a tendency toward bipolar tapering and which had a variable amount of pink-staining cytoplasm. The nuclei of these cells were rather uniform in some places and irregular in others and showed mitotic figures in profusion. The majority of the cells had an oval or boxcar-shaped nucleus which suggested an origin from smooth muscle tissue. They were arranged without a general recourse to pattern although slight perivascular palisading was seen. When the tumor was in proximity to blood vessels, it was viable. In other areas it was extremely necrotic and apparently infiltrated in some areas with inflammatory, cellular material. No estimate of the microscopic invasiveness could be made because virtually all of the tumor was composed of friable or necrotic tissue.

The diagnosis was leiomyosarcoma of the gallbladder and cholelithiasis. The pertinent findings at the postmortem examination are given as follows: (1) leiomyosarcoma of the gallbladder with metastases to the liver, peripancreatic lymph nodes, gastrohepatic omentum and portal vein; (2) icterus; (3) pulmonary congestion and edema; (4) cardiac degeneration and (5) cardiac dilatation.

SUMMARY

A forty-one year old, markedly jaundiced, obese, white female was admitted to the hospital with persistent nausea and vomiting, low grade fever and no pain. A diagnosis of infectious hepatitis was made and the patient improved under intensive therapy. Ascites and an abdominal mass were then noted. Exploratory laparotomy was performed and a large mass in the gallbladder region removed, only to uncover further extensive massing. The patient expired one day after operation. The pathologist reported leiomyosarcoma of the gallbladder and cholelithiasis. This case was very similar to many reported in the literature: occurring in a female, having cholelithiasis with the sarcoma, being advanced when met clinically and being pathologically classed as spindle cell sarcoma, which far outnumbers other sarcomas of the gallbladder. It is interesting to note, however, that the patient retained her weight, had no gastrointestinal upsets prior

to her present illness and had entered the hospital as a febrile, vomiting, jaundiced patient who might very readily be considered as having infectious hepatitis.

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Intractable cases of ulcerative colitis not responding to proper medical regimen must be treated surgically. Often the whole colon has to be removed. Segmental resection with re-establishment of colonic continuity often is followed by recurrence. The rectum must not be left in unless it is completely free of ulcerations, polypi, strictures or fistulas. The amount of colon to be excised at one sitting varies, of course, with the patient's resistance. Usually it is wisest to perform an ileostomy and right hemicolectomy at first and several months later the rest of the diseased colon may be removed. The patient will be left with a permanent ileostomy to which the Koenig-Rutzen bag can be nicely attached. (*Richard A. Leonardo, M.D.*)

INCOMPLETE REMOVAL OF OSTEOID-OSTEOMA*

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OSTEOID-OSTEOMA, since the original description by Jaffe in 1935,[3] has become a well known clinical and readily recognizable roentgenologic entity. Treatment is restricted to a complete removal of the central focus or nidus by surgery. Removal is usually not difficult, and the nidus can be completely eradicated. The following case is reported as an example of the difficulty that may occur when the osteoid-osteoma lies in a relatively inaccessible portion of the skeleton. Six other cases of persistence of an osteoid-osteoma after operation or, perhaps, a recurrence have been found in the literature and were located in the spine, femora, proximal phalanges of the hand and tibia.

CASE REPORT

F. H., a seventeen year old girl, was admitted to the hospital because of pain in the calf muscles of the right leg of one year's duration. The onset had been gradual. The pain had increased in severity and eventually had encircled the entire leg and radiated down the medial aspect to the ankle. The pain had been sufficient to prevent walking and at times had forced her to remain in bed for several days. An ankle support had been used without benefit. There was no history of trauma, fever or chills. She had consulted several physicians. She had moderately severe flat feet and had been treated for it. Examination on December 12, 1946, showed deep tenderness in the calf of the right leg medially and posteriorly, and edema. The white blood cell count was 8,000 with 63 per cent polymorphonuclears. There was no anemia. Phosphatase was 2.4 Bodansky units and phosphorus 2.4 mg. per cent. No fever was demonstrated. Roentgenograms (Figs. 1 and 2) showed a localized area of periosteal new bone formation on the posterior aspect of the tibia. A clear central area is better seen on the overexposed film. (Fig. 2.)

The first operation was performed on March 14, 1947. A longitudinal incision was made posteriorly between the tibia and the fibula retracting the muscles and other soft structures. The swelling and thickening of the cortex of the tibia was removed with an osteotome. The bone was curetted and a fairly large-sized cavity resulted. The wound was sutured in layers without drainage. Dry sterile and pressure dressings were applied.

X-rays taken the following day (Fig. 3) showed that the central clear area had been partially left behind. Microscopic examination of the bone chips removed at operation showed dense bone with focal fibrosis of the marrow spaces. She was discharged.

Pain persisted after operation and was aggravated on standing. There was no fever. Reexamination (Fig. 4) on July 11, 1947, showed the radiolucent nidus still present and new periosteal bone formation in addition to the thick, dense periosteal bone that had been left behind at the previous operation. She was readmitted on February 15, 1948. The white cell count was 9,200 with 59 per cent polymorphonuclears. The Hinton test was negative. The calf was tender anteriorly and laterally, and edema persisted.

The second operation was performed on February 17th. The old scar was excised and the bone exposed through an incision between the tibia and fibula. A large section of posterior tibial cortex was removed extending down about one-third of the anteroposterior thickness of the bone. X-rays were taken during operation and showed that all of the affected bone was removed. The nidus could be seen in an x-ray film of the specimen. The wound was sutured in layers without drainage. Dry sterile and pressure dressings were applied.

Roentgenograms were taken of the specimen as soon as it was removed (Fig. 5) and showed that the clear nidus was in the center of a plaque of dense bone. Roentgenogram of the leg itself showed no residual clear area. The pathologic report (S-48-237) showed a tumor surrounded by dense bone and composed of islands of osteoid tissue with prominent rows of osteoblasts adjacent to them. In the center

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FIG. 1. Right lower leg; note the placque of periosteal new bone.
FIG. 2. Overexposed film showing the clear central nidus (arrow).
FIG. 3. Shortly after the first operation when the new bone was removed; nidus persists (arrow).
FIG. 4. Ten months after Figure 3; rapid formation of periosteal new bone.

FIG. 5. Roentgenogram of the specimen.

FIG. 6. Seven months after the second removal; no activity.

there were a few islands of fat. The marrow spaces were occupied by cellular fibrous tissue. The wound healed readily. (Fig. 6.)

Ten months later the patient was still free from symptoms.

COMMENTS

In this case the location of the osteoid-osteoma in the posterior portion of the tibia beneath the thick muscles of the calf made removal difficult. The wound was of considerable depth before the thick plaque of new bone formation was reached. That the nidus had been incompletely removed was immediately proved by x-rays and also by the persistence of pain in the immediate postoperative days. For nine months before the second and successful operation, the pain and edema increased in intensity.

If the central nidus of the tumor has not been removed, the patient may or may not complain of persistent pain. In our case the pain was present the day after operation and gradually increased. Jaffe[4] reported the incomplete removal of an osteoid-osteoma from the femoral shaft. The patient continued to have pain for two years before a second complete extirpation. Lewis[6] reported the unsuccessful removal of a nidus of osteoid-osteoma from a posterior articulation between the tenth and eleventh dorsal vertebrae. Pain, scoliosis and tenderness persisted until a complete removal was accomplished ten months later.

The postoperative relief of symptoms does not always mean that the patient has been cured. A second group of cases, wherein the first operation had been incomplete, showed loss of symptoms for a varying number of days or months and then a recurrence. Ponseti reported the incomplete removal from the proximal phalanx of a finger and relief of symptoms for only a few days. His patient was only nine years of age. Jaffe reported an incomplete removal from the neck of a femur in a lad of thirteen. The symptoms disappeared for twelve months. After a year the same symptoms recurred and necessitated a complete removal. Lewis' case (No. 9) was in the proximal phalanx of the finger and was proven to have been left behind at operation by an immediate postoperative roentgenogram. One month later a successful eradication was performed.

From these cases it is evident that if the central nidus of osteoid tissue is not removed or

only partially removed, the symptom of pain may persist and give the surgeon immediate indication of incomplete operation, or the pain may disappear for several days or months only to recur. The use of films during operation to prove that the nidus is in the specimen and also

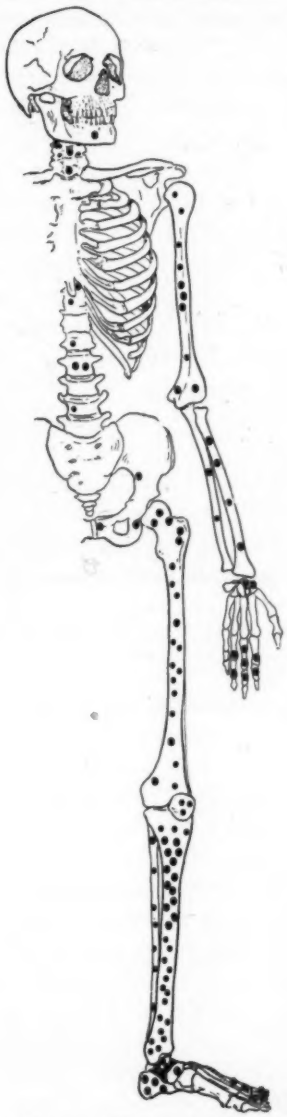

FIG. 7. Sites of osteoid osteomas reported in literature.

out of the bone is therefore imperative. This is true when the lesion lies deep in the skeleton as in the spine or femur or is superficial in a finger.

Cure of an osteoid-osteoma can only be effected by complete removal of the central nidus, and not by removal of the reactive periosteal bone over it, or a partial curettage of the central "tumor." The recognition of the nidus at operation depends upon its correct localization before operation by roentgenograms. (Figs. 7 and 8.) (Table I.) The central nidus may lie in the subperiosteal, cortical or medullary portion of the bone. (Table II.) The central area usually measures 1 to 1.5 cm. in size. It may be obvious in the x-ray or hidden behind a thick layer of

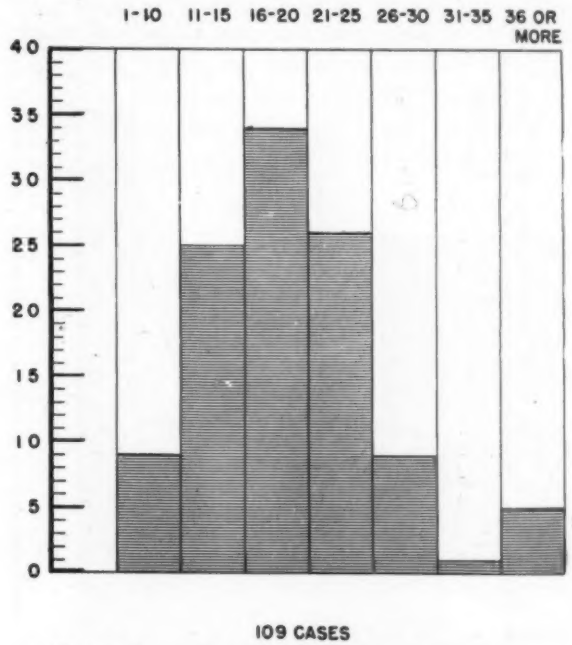

FIG. 8. Ages of patients at onset of symptoms.

periosteal new bone formation or in a larger area of medullary osteitis.

The central nidus does not always have the same appearance and manifests itself in the x-ray in five different forms. (Table III.) Some authors believe that the varying appearance of the central nidus signifies different stages of development. This has not been fully worked out as yet. The most common central lesion is a clear, radiolucent area without any rim of sclerosis; the lesion may be buried in a large mass of sclerosed bone. Such a radiolucent area in the medullary cavity may resemble the "punched out" lesion of multiple myeloma, certain solitary cartilaginous tumors or abscess.[9]

The second common form is a well defined sclerosed or dark center with a thin, clear band of radiolucency around it. Less common are a radiolucent or clear area with a thin rim of sclerosis around it and normal bone outside of the latter, a solitary ovoid densely calcified area in normally textured bone, and rarest of all, a double lesion with two adjacent, clear, oval areas. Two cases of small adjacent lesions have been reported.[7,12] This changes the original and

usually accepted concept that an osteoid-osteoma is a solitary lesion. Only three cases have been reported (5 per cent) in which a center could not be demonstrated because of dense bone around it. In these cases the entire area of

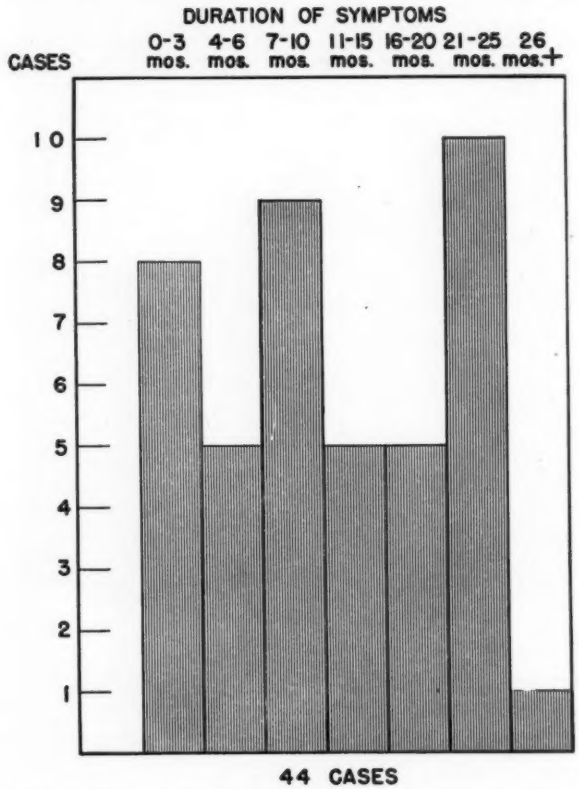

FIG. 9. Duration of symptoms before roentgenograms.

sclerosis had to be removed to be certain that all of the osteoid tissue had been eradicated.

There has been considerable discussion as to the evolution of an osteoid-osteoma in a patient. Some authors[11] believe that an osteoid-osteoma starts as a clear radiolucent area, and the surrounding bone becomes sclerosed later on. Others[5] believe that the lesion may start as a dark center which later becomes radiolucent. However, when the patient first reports for x-ray examination, the osteoid-osteoma may have any of the appearances enumerated before and may have little or a large amount of sclerosis or periostitis around it. The appearance of the lesion cannot be correlated with the duration of symptoms. (Fig. 9.) The x-ray appearance may be the same when symptoms have lasted a few months or as long as two years. Symptoms typical of this disease may be present, and x-rays may be entirely normal.[3] In some cases it has been proven that a general rarefaction of the bone or bones occurs around the painful area before a distinctive center appears. In four cases periostitis or an area of osteitis was present for as long as eight months before a nidus appeared. In the latter

TABLE I
LOCATION OF OSTEOID OSTEOMAS REPORTED IN LITERATURE

Spine	9	
Mandible	1	(Anterior)
Rib	1	(Ninth rib)
Humerus	10	
Ulna	2	
Radius	4	
Carpal scaphoid	2	
Phalanges (manual)	7	
Pelvis	3	
Femur	20	
Patella	3	
Tibia	31	
Fibula	7	
Talus	5	
Os calcis	4	
Tarsal scaphoid	1	
2nd metatarsal	1	
Phalanges (pedal)	5	

TABLE II
LOCATION OF CENTRAL NIDUS: 58 CASES

Cancellous bone	24
Cancellous bone erupting out through cortex	3
Border of medullary canal and cortex	4
Cortical	19
Cortical erupting out under periosteum	1
Sub-periosteal	7

TABLE III
TYPE OF CENTRAL NIDUS BY X-RAY 55 CASES

Radiolucent center	24
Radiolucent center c Rim of sclerosis	8
Dark center	3
Dark center with clear rim	18
No center demonstrable	3
Double lesions	2

cases the nidus was clear in 50 per cent and calcified in 50 per cent when first seen on serial roentgenograms.

In a few cases the nidus has been seen to grow when films taken several months apart were compared. Growth was at a very slow rate. One case showed a 5 mm. increase in diameter of a central lesion over a period of eight months.

Usually when an osteoid-osteoma has been demonstrated by the x-ray to be the cause of the patient's symptoms, it has been removed, and its further metamorphosis unknown. It is believed that an osteoid-osteoma might eventually cure itself by sclerosis, but this would take many months or years. In a single case

reported by Sherman[12] and, of course, unproven by biopsy, a clear central nidus was completely replaced by dense osteitis after a period of twenty-four years. On the first films there had been considerable reactive osteitis around the center, and this had not changed in size or appearance in the twenty-four years. The center was no longer present.

The symptomatology of this disease is well known. Pain is usually persistent, nagging and may prevent sleep. The pain may be sufficient to cause muscle splinting and even limping. The muscular spasm and splinting may lead to actual atrophy of the muscles involved. When the lesion is near a joint, there may be joint stiffness and even an effusion into the joint. The soft tissues over a lesion may be swollen and often are tender. The temperature of the skin over the lesion is usually not changed. Three cases have been reported, however, in which the soft tissues over a lesion were definitely warmer than elsewhere.

The systematic use of x-rays will lead to complete extirpation (1) by accurate localization of the central nidus on preoperative films, (2) by placing a needle or similar object on the skin or in the soft tissues directly over the lesion and (3) by x-rays of the bone as soon as removal has been thought to be complete by the surgeon. The latter can be taken by a portable x-ray machine in the operating room. (4) X-rays of the specimen should be made in the operating room in two planes so as to demonstrate that both the front, back, and, also, both lateral aspects of the nidus are present in the specimen. (5) Final check is made by x-ray of the bone as soon as the operation is completed. This is not as opportune a time as during the operation. The wound would have to be reopened if the x-rays showed residual tumor. We believe that the use of x-ray localization in the steps described will result in a complete removal.

SUMMARY

1. A single case of incomplete removal of an osteoid-osteoma from the tibia is reported. Persistence of the symptoms after the operation necessitated a second exploration for residual tissue left behind. Six similar cases were found in the literature.

2. Following an incomplete operation the characteristic pain may either persist or may disappear for several months before recurring.

3. The use of x-ray localization before and during the operation can demonstrate whether or not the lesion has been removed and is in the resected specimen of bone. X-ray of the bone during the operation is strongly urged.

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OVARIAN PREGNANCY*

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IN recent years there has been an increasing number of ovarian pregnancies reported. This may be due to better diagnostic facilities and possibly to the increase in the number of residents and fellows.

In 1932 Wollner[4] culled forty-eight cases from the literature. Four years later Russell and Black[2] added four and seven more cases were added by Wilson and Robins,[1] bringing the total to fifty-nine. Since this report I have been able to find twenty-five additional cases including the present report bringing the total to eighty-four. The number is still small and another case seems worthy of reporting.

According to Nichols[3] thirty-eight cases were carried to viability (seven months and beyond) and resulted in twelve living babies and twenty-two living mothers. According to Thro[8] the embryo is frequently absent.

In 1887 Spielberg formulated four criteria which must be satisfied to establish the diagnosis of ovarian pregnancy. They are the following: (1) the tube on the side of the ovary must be intact; (2) the fetal sac must occupy the position of the ovary; (3) the ovary must be connected to the uterus by means of the utero-ovarian ligament and (4) definite ovarian tissue must be found in the wall of the sac.

Two types of ovarian pregnancies are recognized, namely, the intrafollicular type and the superficial type. Some authors prefer to call them primary and secondary types. The primary type corresponds to the intrafollicular type in which the fertilized ovum undergoes its development entirely within the ovary; the secondary or superficial type is one in which the ovum is fertilized elsewhere, usually in the fallopian tube, and becomes implanted on the ovary.

The etiology of ovarian pregnancies has not yet been solved satisfactorily. Wollner[4] believes there is some alteration in the ovulation processes. He states that there is some reason for the ovum not leaving the follicle after rupture and this may be accounted for in two ways. (1) The occlusion of the rupture by a small blood clot makes the expulsion of the ovum impossible. This is not a likely explanation because such an occlusion would prevent the entry of the sperm into the follicle. (2) The ovum in the ripening follicle is dislocated so that it does not get into the stream of escaping fluid allowing it to remain in the follicle to be fertilized.

Wollner further states that the most logical explanation for the ovum to be retained in the follicle is the force required to free it from the cumulus oophorus is not present due to the altered intrafollicular pressure from increased resistance of the surrounding tissue. Any pathologic process involving the tunica is likely to alter ovulation. Normally the sudden change within the follicle carries the ovum out, but in cases in which the wall's resistance is increased the sudden intrafollicular change does not take place and the possibility of the ovum remaining in the follicle is increased. Such a condition would be found in chronic oophoritis which is the likely reason for the ovarian pregnancy to be presented. In most of the cases reported there is a long-standing sterility which would tend to bear out the possibility of infection; this too was present in this case.

McKenzie,[5] Curtis[6] and Sutton[7] believe endometriosis plays a role in the etiology of ovarian pregnancies.

The diagnosis of ovarian pregnancy cannot be distinguished from tubal pregnancy as the signs and symptoms are the same. One may suspect an ovarian pregnancy if the gestation has gone beyond eight weeks as they are prone to remain intact for a longer period of time. Wollner believes that many diagnoses are missed at operation due to the great resemblance to chocolate cysts and the lack of sufficient microscopic examinations.

The following case report is of interest:

Mrs. N. P., white, aged twenty-nine years, entered Touro Infirmary on February 17, 1948.

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She was first married at the age of fourteen for two years during which time there was a criminal abortion. This was apparently uncomplicated. The patient was again married at the age of nineteen years at which time she suffered a severe pelvic inflammatory condition which made it necessary for her to remain in bed for six months. Two years after this marriage there was a spontaneous abortion of a three-month gestation. The menstrual history is perfectly normal until after December 10th when she had her last normal period. There was vaginal bleeding approximately every two weeks until January 27th when vaginal bleeding resembling a normal menstruation was noted. Since this date there has been bleeding every eight to ten days lasting for one day and not profuse.

She was seen for the first time on February 16th complaining of pain which had been present for ten days. This pain had become worse since the onset and was most severe when the patient coughed or sneezed. Intercourse was tried once but was not tolerated.

Physical examination revealed her blood pressure was 110/60, pulse 85, temperature 98.6 and respirations 20. The patient was a well nourished and well developed female who did not appear ill or in any distress. The abdomen was flat and was only tender on deep pressure in the right lower quadrant. Pelvic examination revealed a relaxed outlet with Skene's glands and Bartholin's glands negative. The cervix was somewhat soft and extreme pain was experienced upon manipulation. A tender mass was in the cul de sac on the right side. The uterus was in a second degree retroversion. The left adnexa appeared negative. A cul de sac puncture revealed a small amount of dark blood which did not clot.

Laboratory data were as follows: red blood count, 4,500,000; hemoglobin, 12.4 gm. per cent and white blood count, 9,900.

Differential, polymorphonuclears, 55 per cent; eosinophiles, 3 per cent; lymphocytes, 34 per cent and monocytes, 8 per cent. Urine was negative. Sedimentation rate was 13 mm./45 minute. Serology was negative. The diagnosis of a right ectopic pregnancy was made.

Under general anesthesia the abdomen was opened through a midline sub-umbilical incision. Upon opening the abdomen a small amount of blood was present in the pelvis and the right ovary was adherent in the cul de sac. It was considerably enlarged and the adherent portion was hemorrhagic. This ovary was removed. The corresponding tube was free and patent so it was not removed. The left tube was coiled about the corresponding ovary in the typical retort-like manner. It was freed and removed in the usual manner. A small fibroid on the fundus was removed.

The patient made an uneventful recovery and was discharged from the hospital on her eighth postoperative day.

The pathologic report was as follows: "The ovary is 6 cm. in length and 3½ cm. in width by 3 cm. in thickness. Externally it is lobulated and presents for approximately one-half of its external surface a pale yellow, relatively smooth appearance. The remaining portion of the external surface is of a dirty, reddish yellow appearance and relatively smooth. The external surface of the ovary appears intact. On section the pale yellow portion of the ovary presents numerous cystic areas containing clear fluid. These cystic areas vary from a few mm. to 2 cm. in diameter. The remaining portion of the ovarian tissue is well delineated from the cytic area just described and presents on section a hemorrhagic tissue which in some areas is distinctly yellow and presents two saccular cystic cavities which contain clear fluid. The largest of these, approximately in the center of the hemorrhagic tissue, is about 2 cm. in diameter. Adjacent to this cystic structure is a smaller cyst of similar appearance. Diagnosis: ovarian pregnancy showing chorionic villi, two separate amniotic sacs and hemorrhage with necrosis of adjacent parts. In spite of careful search, it is not possible to identify fetal remnants. There was no obvious break in the external surface of the ovary but the blood in the peritoneal cavity suggests that one must have been present."

CONCLUSIONS

1. A case of ovarian pregnancy is presented that satisfies the criteria set forth by Spielberg.
2. This case further substantiates the idea that changes in the ovarian surface which may be brought about by infection alters ovulation, making ovarian pregnancies possible.

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Occasionally a rather atypical case of acute coronary infarction is present and, irrespective of whether it is anteriorly or posteriorly situated, it may produce symptoms simulating an acute abdomen. More than one surgeon, although they do not care to admit it, have undoubtedly opened the abdomen to find it negative and later be shown by definite electrocardiographic evidence that the case was one of acute coronary occlusion. (Occasionally cases of diaphragmatic pleurisy also mislead the abdominal surgeon.) What surprised me, however, was to learn that occasionally acute abdominal disease may not only simulate coronary occlusion, clinically, but also even produce electrocardiographic changes similar to those present in bonafide cases of acute coronary occlusion. It is no wonder, therefore, that once in a while even the best of surgeons and diagnosticians will make erroneous diagnoses in atypical cases of this type. The unfortunate thing is that such an erroneous diagnosis may cost the patient's life. One of the most common errors is to attempt a cholecystectomy upon a patient with an acute coronary infarct. Besides, we must realize occasionally a patient may have both diseases; then the treatment of the surgical condition, unless it is a great emergency, must await the patient's convalescence from his acute coronary lesion. (*Richard A. Leonardo, M.D.*)

RUPTURED UTERUS DUE TO PLACENTA PERCRETA

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INVASION of the uterine surface by the chorionic villi is limited by protective elements in the decidua basalis. Wislock[1] has shown the presence of a mucopolysaccharide in the decidua that serves to limit trophoblastic erosion of maternal tissue. Microscopic sections from most cases of placenta accreta show an absence of the decidua basalis and atrophy of the decidua vera. The degree of invasion of the chorionic villi whether superficial, deep or entirely through the myometrium has given rise to the terms accreta, increta and percreta. Irving and Hertig[2] in 1937 recorded the most complete survey of placenta accreta (eighty-six cases including eighteen personal cases). The authors' findings showed that in over three-fourths of the cases the decidua, which serves as a line of cleavage for the separation of the placenta, was compressed and contained few or no glands. In almost all cases the chorionic villi could be seen invading the myometrium. The first recorded case of rupture of the uterus due to placenta percreta was that by Alexandroff[3] in 1900. In his case a hysterectomy was performed and the patient lived. A review of the literature by Hertig and Irving up to 1937 covering eighty-six cases of placenta accreta showed only four instances of spontaneous rupture due to chorionic villi penetrating the visceral peritoneal surface of the uterus. The case reported herein illustrates such a condition.

CASE REPORT

N. B., a white married female aged twenty-six years, gravida III, Para I, was admitted with a history of having been awakened at 6 A.M. on May 25, 1949, by a knife-like pain in the epigastrium and an inability to breathe.

The patient's previous history was relevant to the case. She had had a miscarriage after a pregnancy of three months in 1943, with retention of placental elements for which a curettage was done three months later. She had abnormal menses with intermenstrual bleeding thereafter and abdominal pains until 1945 when she became pregnant. This resulted in a normal delivery in 1946 with retention of a portion of the placenta. She bled for one month and a curettage was done. The record described the curettings as a "large amount of soft bloody material but no placental elements could be recognized." Diagnosis was subinvolution of the uterus with chronic infection.

In the present pregnancy her expected date of confinement was May 26, 1949. She was admitted in threatened premature labor on April 16, 1949. Her complaint at this time was upper abdominal pains but no contractions were observed. The fetal heart was found to be good. After morphine and bed rest she was discharged in thirty-six hours.

At her admission on May 25, 1949, she was seen within ten minutes of her arrival and within twenty minutes of the onset of symptoms. She presented a picture of increasing shock, cyanosis, blood pressure of 70/50 and pulse of 120 with poor volume. The abdomen was board-like above the bulge of the uterus. The fetal heart could be heard faintly. Glucose in saline and one unit of plasma were given and suitable donors were obtained within one hour. She was taken to the operating room at 7:40 A.M., one hour and twenty-five minutes after admission. In spite of the intravenous fluids, plasma and 400 cc. of blood her blood pressure never rose above 70/50. On opening the peritoneum pure unclotted blood not diluted with amniotic fluid was released under great pressure. The right cornual region of the fundus showed a clear punched out area larger than a silver dollar through which a lobe of the placenta was protruding. A recently deceased fetus was extracted through a low fundal incision and the placenta was peeled off easily except for an area about 1 inch wide around the perforation. This 1 inch border was excised to get back to thicker myometrium and both this excised portion and the cesarean incision were repaired with three rows of continuous chromic No. 0 catgut. Despite 4 pints of blood given under oxygen pressure for rapid delivery

the patient's condition on the operating table was considered too weak for hysterectomy. The tubes were hastily ligated and the peritoneum closed. Her condition, although shaky for forty-eight hours, steadily improved until her discharge on the eighth postoperative day. She was seen at home on June 10, 1949, feeling well.

Frozen section revealed fibroblastic proliferation and round cell infiltration in the margin of myometrium examined. The decidua basalis could not be seen.

ETIOLOGY AND TREATMENT

An etiologic background had been proven in only six of Irving's personal cases. Previous retained placentas, endometritis and old cesarean scars were thought to lead to an atrophied decidua basalis. Some authors have indicted the endocrines, particularly the corpus luteum, for the failure of the decidua. In the case presented there may well have been either penetration of the uterine wall by the curette or endometritis following the miscarriage in 1943. Also significant was the retention of a portion of the placenta after delivery in 1947. The frequent association of placenta accreta with placenta previa points toward previous endometritis as an etiologic factor.

In spite of the good results with hysterectomy recorded by some of the earlier authors manual removal still held sway as the treatment for placenta accreta up to 1925 with a high mortality (66 per cent in thirty cases), whereas hysterectomy employed in Irving and Hertig's eighteen cases showed less than 6 per cent mortality. Obviously the type of case will dictate the treatment. In cases in which there is accreta partial separation is the rule and external bleeding is present. Failure to find a line of cleavage in attempted manual removal should lead to the diagnosis; hysterectomy is the surest cure. In placenta increta and total accreta which is rarer and when there is no external bleeding many obstetricians (after John O. Polak's memorable case in 1916) have let the placenta remain for days or even weeks to have it slough out. With the still rarer placenta percreta one has no choice but to operate.

SUMMARY

A discussion of placenta accreta, increta and percreta is presented. A case of the latter with spontaneous uterine rupture is given. An etiologic theory is offered through the experiments of Wislocki and the recorded data of Irving. The etiology of either infection or trauma causing endometrial damage seems logical in the case presented herein. Treatment of the various types is also summarized.

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INGUINAL ULCER*

FIRST SIGN OF CANCER OF THE CECUM

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THE perplexity of the clinical picture that characterizes cancer of the cecum is well known to surgeons, and the difficulty in diagnosing the lesion early has led to many useful hints and classification regarding its clinical course. The case described herein is of special interest as it represents a rare form of the disease which, when unsuspected, is likely to be treated for an inflammatory condition. Thus valuable time is lost before eradication of the cancer is attempted.

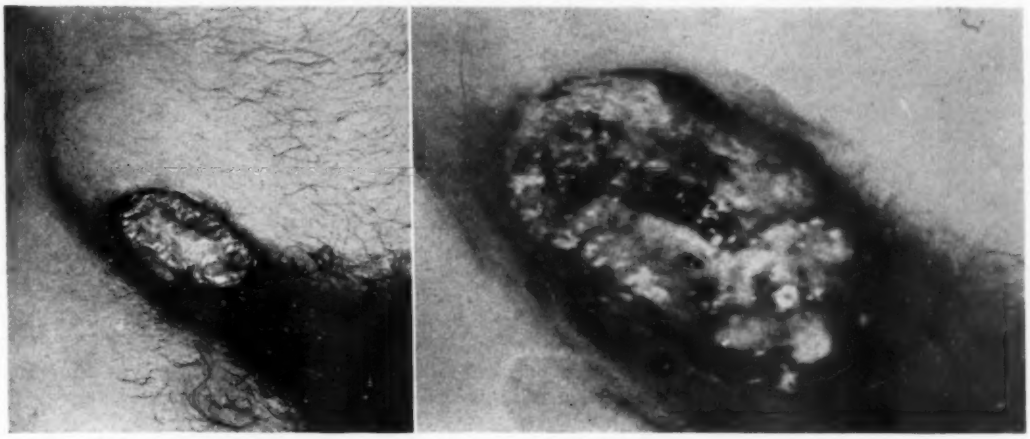

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FIG. 1. Frontal view of the ulcerative lesion in the right groin.
FIG. 2. Same lesion on close-up before biopsy illustrating crater-like center; there was no sinus tract communicating with the bowel; small amounts of yellow, serous drainage.

CASE REPORT

A thirty-four year old white male veteran was admitted to Oliver General Hospital on June 19, 1948. His family history was non-contributory. He was perfectly well until eight months previously when he noticed pain in the right groin, hip and thigh. He consulted a doctor who prescribed hot wet towels to the area. One week later x-rays of the right hip and thigh were reported negative. The patient then went to a chiropractor who told him that his hip was out of joint and gave him a course of several rubdowns. After this he felt better.

One month later a small, walnut-sized mass appeared in the right groin. He consulted another doctor who told him he had an "infected gland," incised it and it has been draining since. A course of penicillin and sulfa pills was given intermittently for three months without favorable response. The mass remained the same size, continued to drain, but caused little pain and did not interfere with his work as a carpenter.

One month ago he consulted another doctor who took a blood test, "cultures" and resumed penicillin and sulfa treatment. After one month of this therapy the patient was received at this hospital for admission. He had lost no weight, his bowel movements were regular as before and his appetite as good as ever.

Physical examination revealed a well developed and well nourished male in excellent general health. In the right lower quadrant there was a large, non-tender, hard, indurated, ulcerative mass with a crater measuring 6.0 cm. by 3.5 cm. In its center a small draining sinus tract would exude a few drops of yellowish, watery, odorless liquid, on pressure. No inguinal

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FIGS. 3 and 4. Barium enema: "The barium proceeded steadily and without obstruction to fill the colon up to the hepatic flexure, but it was only with difficulty that it was introduced into the ascending colon. The possibility that at least part of the failure to fill the cecum well was due to retained feces was considered. However, a stereo film following evacuation is strongly suggestive of malignancy."

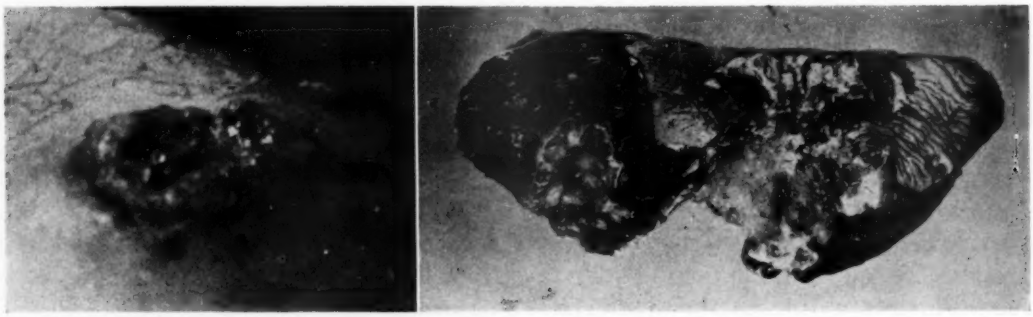

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FIG. 5. Side view of ulcer showing raised, indurated border.
FIG. 6. Specimen removed at operation containing ulcer surrounded by normal skin; note invasion of abdominal wall outside the main tumor mass on the left. (Lower portion of specimen has been removed for microscopic study.) The appearance suggests contiguity of the lesion rather than a lymphatic spread.

or femoral lymph glands were palpable; no lesion was found on the genitalia. Venereal disease was emphatically denied. The liver, spleen or kidneys could not be felt. (Figs. 1 and 2.)

Laboratory findings were as follows: urinalysis negative; red blood count 4.6 million; hemoglobin 14.4 gm. per cent; white blood count 7,600; normal differential count; blood Wassermann and Kahn negative. Sedimentation rate (corrected) was 34 mm. per hour. The Frei test was negative.

The patient's pulse and temperature were consistently within normal limits. At first we were undecided whether this lesion was inflammatory (lymphopathy, venereum, blastomycosis, etc.) or neoplastic. A biopsy report quickly settled the argument: "Adenocarcinoma, mucous cell, metastatic, presumably arising in the large bowel or appendix." Gastrointestinal series: "On three-hour examination the barium is noted in the terminal ileum and also in the transverse and descending colon. The cecum does not fill well. On the five-hour

film there is some barium seen in the cecum." Barium enema: "It was only with difficulty that the barium was introduced into the ascending colon. Although the possibility of retained feces should be considered, there did appear to be a constant filling defect in the cecal region." (Figs. 3 and 4.)

Exploration on July 13, 1948, revealed an extensive, obviously inoperable carcinoma completely effacing the anatomy of the terminal ileum, cecum, appendix and ascending colon. Resection of this mass was impossible, but a large section of the tumor was removed to allow closure of the abdominal wall, and an ileotransverse colostomy was performed. The patient stood the operative procedure well. He was given some palliative x-ray therapy postoperatively. There was slight serous drainage along the skin incision, but no palpable mass was noted in the groin. He was discharged from the hospital on August 27, 1948, fully ambulatory. (Figs. 5 and 6.)

The pathologic report of the specimen removed at operation confirmed the aforementioned diagnosis. (Fig. 7.) This patient died at another hospital in January, 1949.

FIG. 7. Section from the margin of the ulcer; the crater is lined by anaplastic, high, columnar epithelium. Cancer cells resembling intestinal mucosa are invading the surrounding skin.

COMMENT

The occurrence of cancer of the cecum in a man thirty-four years old is not surprising. Within a few weeks of this patient's admission to the hospital, two other patients were operated upon by us, one twenty-four and another thirty-six years of age. Numerous reports of cecal cancer have been reported affecting individuals in their twenties,[10,15,18] the earliest in a child six years of age.[15]

Rankin and Graham[22] have subdivided the frequently bizarre clinical features into three groups, namely, the dyspeptic group, usually treated for appendicitis or cholecystitis; the group characterized by anemia and weakness of unexplained origin; the group in which tumefaction is frequently discovered accidentally or in the course of a routine physical examination without having previously produced symptoms.

We have treated representative patients of each group, one of which was a young airplane pilot, twenty-four years of age, who had an incision and drainage for appendiceal abscess and later an appendectomy elsewhere. Six months later we encountered a large carcinoma of the cecum that has widely invaded the retroperitoneal space, and McLaughlin[18] has given a splendid review of eighteen cases of cecal cancer associated with acute appendicitis. In most of these the neoplasm was masked by the associated inflammatory process. The value of taking a biopsy of the "inflammatory wall" cannot be underestimated as this will frequently give the first evidence of any underlying neoplastic process and will save precious time for the surgeon.

In another thirty-six year old soldier we were about to do an abdominoperineal resection for proven cancer of the rectum when, during routine exploration on the table, we discovered a mass in the right lower quadrant. Palpation and frozen section revealed a coexistent primary cancer of the cecum. There has been no clinical evidence of such a lesion prior to operation, and without a biopsy it had a good chance of being missed. Multiple primary cancers of the colon are not too rare and have been reported by a variety of authors,[1,4,11,21,25] in some series[14] as high as 3.5 per cent of 200 cases of carcinoma of the colon.

In order to prevent prolonged non-surgical treatment of cancer of the cecum, it would seem that as it is the practice to take a piece of all questionable inflammatory lesions about the appendix for frozen section, one should not hesitate to biopsy ulcerative lesions of the groin when venereal disease cannot be readily demonstrated.

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